INSTRUCTIONS

FOR THE

ERECTION & MAINTENANCE

OF THE

MODEL 8A-5 AIRPLANE

I-C-5 5

SALES ORDER 300   DETAIL SPECIFICATION 85-C

EL SEGUNDO DIVISION

DOUGLAS AIRCRAFT CO., INC.

EL SEGUNDO CALIFORNIA, U.S.A.

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P R E F A C E

The information contained herein is the result of factory and operators' service experience and constitutes the generally accepted practice of maintenance procedure for this particular airplane.

These instructions are furnished for the operators' information and without any warranty incident thereto. Furthermore, the Douglas Aircraft Company reserves the right to make changes to this information at such a time that advanced methods of maintenance may be forthcoming from the above sources.

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SECTION I

INTRODUCTION & REFERENCES

This handbook contains descriptive data and instructions for the erection, alignment, maintenance and disassembly of the Douglas Airplane, Model 8A-5.

The handbook has been divided into sections dealing with the wings, fuselage, flight controls, etc. These are in turn sub-divided into description, installation, operation, etc. The subject indexes should be used to find the location of any particular discussion in the text.

These sections are designated or numbered with the Roman Numerals and the page numbers of each section are identified with the Arabic Numerals. Illustration: page 6, of Section XII, is designated in the upper right corner of the page as XII - 6.

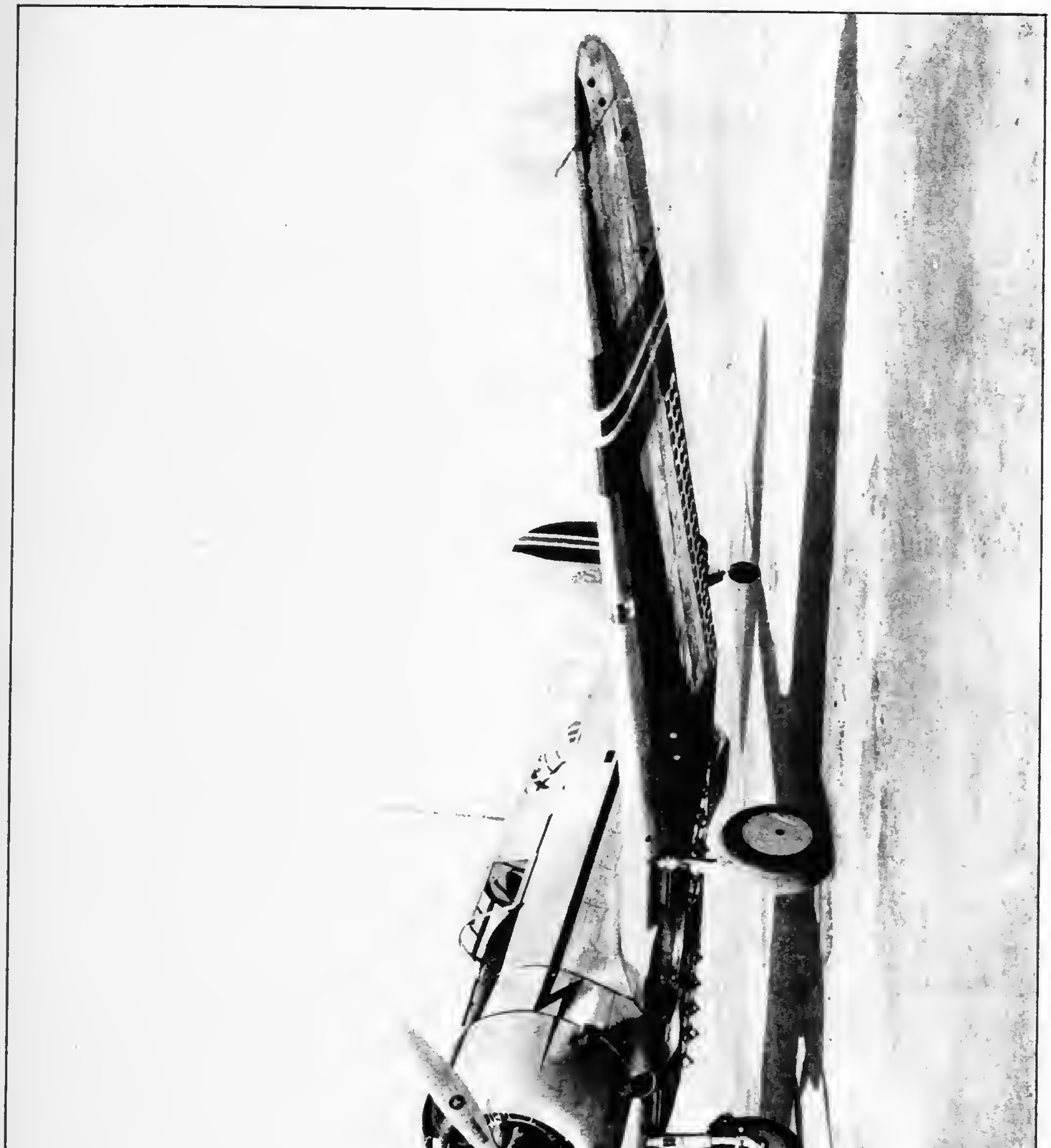
The text is amply supplemented by diagrammatic sketches of the various installations such as control systems, fuel lines, etc. Photographs are carefully interspersed throughout the entire text.

The maintenance of some installations on this airplane are dealt with in handbooks or manuals issued by the manufacturers of aeronautical equipment and parts. These publications are referred to in this handbook when they contain applicable information.

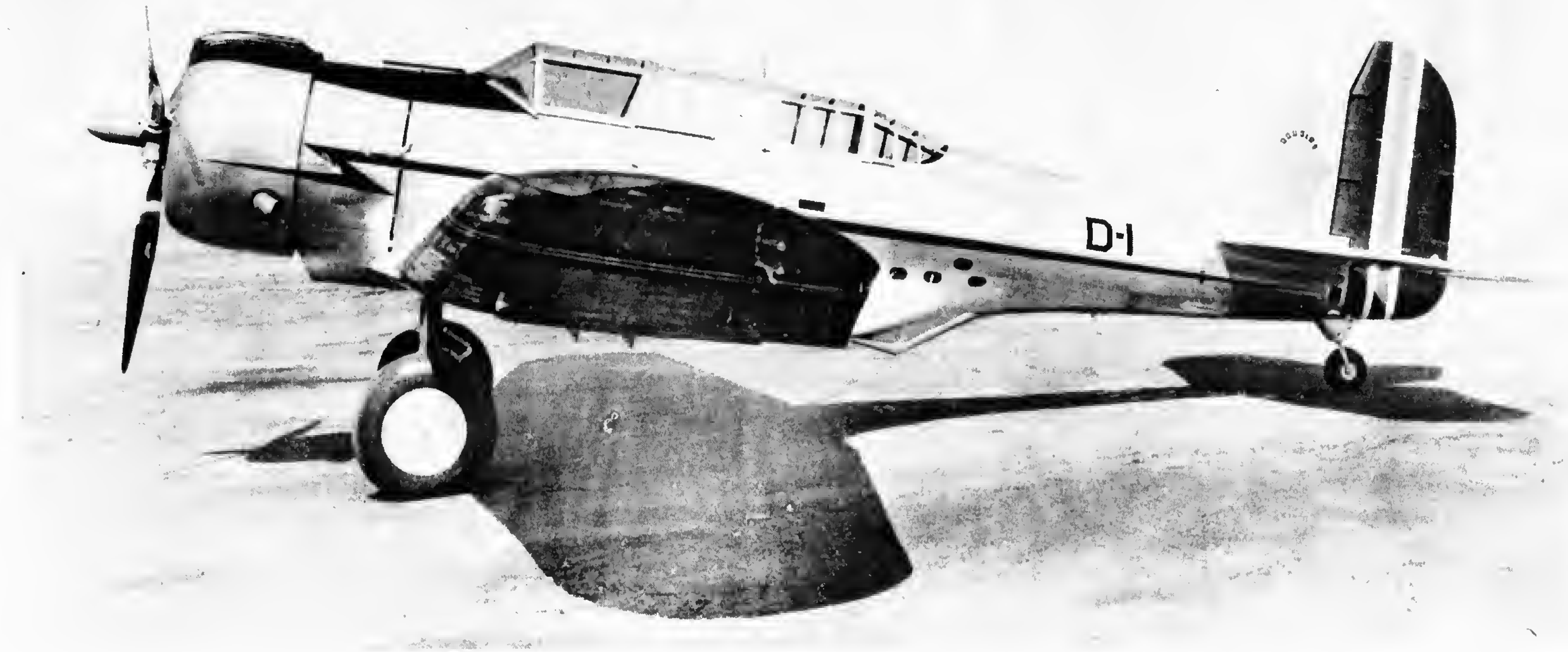
The equipment, assemblies, and parts installed on the 8A-5 airplanes have been, as far as possible, made interchangeable, and to conform with the Government of Norway Detail specifications #85-C, Dated February 27, 1940.

The dual controls in the rear cockpits are interchangeable with all other airplanes called for in this contract.

8235 Front View



8231 - Left Front View



8233 - Side View

SECTION II

DESCRIPTION

A. DIMENSIONS

1. General Dimensions

Over-all Span	47 ft. 8 3/4 in.	(14.55 m.)
Over-all Length	32 ft. 6 in.	(9.92 m.)
Over-all Height, Thrust Line Level, (Top of Vertical Stabilizer)	12 ft. 6 1/8 in.	(3.31 m.)
Over-all Height, At Rest (Blade Tips)	10 ft.	(3.05 m.)
Height, Propeller Hub, Thrust Line Level	5 ft. 7 in.	(1.70 m.)
Height, Propeller Hub, At Rest	7 ft. 3 in.	(2.21 m.)
Clearance, Propeller Tips, Thrust Line Level	8 1/8 in.	(20.6 cm.)

2. Tail Wheel

Size	13 1/4 in.	(33.6 cm.)
Air Pressure (Maximum)	36 lbs/sq.in.	(2.5 kgs/cm^2)

3. Landing Gear

Tread, From Centerline of Each Tire	11 ft.	(3.35 m.)
Size of Tire	36 in.	(91.4 cm.)
Air Pressure, Each Tire	41 lbs/sq.in. 37	(2.8 kgs/cm^2)

4. Wing

Airfoil Section: Root Section N.A.C.A. 2415, Tip Section 2409

Total Area Including Ailerons	363 sq. ft.	(33.74 m^2)
Span, Total	47 ft. 8 3/4 in.	(14.55 m.)
Chord, M.A.C.	96.9 in.	(246.1 cm.)
Chord - Maximum	114 in.	(289.5 cm.)
Dihedral	5.5°	
Incidence	2.5°	
Sweepback	5.0°	

5. Ailerons (Each) 21° up 15° dn

Area Aft of Hinge Line (Less Tab)	10.35 sq. ft.	(.961 m^2)
Area, Balance	2 96 sq. ft.	(.274 m^2)
Area of Tab	.59 sq. ft.	(.054 m^2)
Area, Total	13.90 sq. ft.	(1.291 m^2)

6 Horizontal Stabilizer

Over-all Span	17.6 ft.	(5.36 m.)
Setting (Fixed)	$-.5^{\circ}$	
Area (Effective)	35.8 sq. ft.	(3.325 m^2)

7. Elevators (Each) 30° opp 20° ned

Area, Aft of Hinge Line (Less Tab)	9.60 sq. ft.	(.891 m^2)
Area of Balance	3.20 sq. ft.	(.297 m^2)
Area of Tab	1.33 sq. ft.	(.123 m^2)
Area, Total	14.13 sq. ft.	(1.311 m^2)

8. Vertical Stabilizer

Area	9.7 sq. ft.	(.901 m^2)
Setting (Fixed)	2.5° left	

9. Rudder 30° hver vei

Area, Aft of Hinge Line (Less Tab)	13.60 sq. ft.	(1.263 m^2)
Area, Balance	2.90 sq. ft.	(.269 m^2)
Area of Tab	.60 sq. ft.	(.055 m^2)
Area, Total	17.10 sq. ft.	(1.587 m^2)

trimror = 10° hver vei

10. Landing Flaps

Area, Total	49.80 sq. ft.	(4.626 m^2)

11. Engine

Wright, Model GR 1820-205A rated at 1000 h.p. at 2300 r.p.m. from S.L. to 2130 m. altitude.

Fuel	90 Octane
Oil (W.A.C. Spec.)	No. 5817
Fuel Consumption:	
Military Rating (2500 r.p.m.) low blower - approximately	139 gal/hr. (527 liters/hr.)
Cruising (1900 r.p.m.) low blower - approximately	44 gal/hr. (116 liters/hr.)
Cruising (1900 r.p.m.) high blower - approximately	50 gal/hr. (189 liters/hr.)
Oil Consumption:	
Military Rating (2500 r.p.m.) - approximately	3 gal/hr. (11.3 liters/hr.)
Cruising (1900 r.p.m.) - approximately	1.5 gal/hr. (5.6 liters/hr.)
Oil Temperature, Normal	74°C. to 88°C.
Oil Temperature, Emergency	104°C.
Oil Pressure, Desired	4.56 to 5.27 kgs/cm^2.
Oil Pressure, Minimum (Idling Speed)	2 to 4 kgs/cm^2.

12. Propeller (Curtiss 3 blade multi-position and/or constant speed)

Diameter	10 ft. 6 in.	(3.20 m.)
Blade Settings	20.4° low pitch	
	45.4° high pitch	

B. WEIGHTS

1. Weight Empty

Crew:	two at 90 kgs. each	180 kg.
Fuel:	Capacity 953.8 liters, including reserve of 206.2 liters	685.8 kg.
	Normal Load, 567 liters	408.2 kg.
Oil:	Capacity 101 liters	88.4 kg.
	Normal Load, 64 liters	57.8 kg.

2. Armament

Guns:	Fixed - Four .30 caliber, each	9.4 kg.
	Two .50 caliber, each	29.0 kg.
	Flexible - One .30 caliber, each	10.2 kg.
Ammunition:	- .30 caliber per 1000 rounds	29.4 kg.
	.50 caliber per 100 rounds	11.3 kg.
Bombs:	50 kg. - 8	400 kg.
	50 kg. - 4 & 20 - 20 kg.	600 kg.
	50 kg. - 6 & 20 - 20 kg.	700 kg.
	225 kg. - 3	675 kg.
	225 kg. - 4	1000 kg.
	225 kg. - 2 & 20 - 20 kg.	850 kg.

3. Flares, Parachute - Two .... 38 kg.

4. Weights Loaded

Weight for Normal Attack Mission	3401.9 kg.
Weight for Normal Bombing Mission	3900.8 kg.
Wing Loading for Normal Attack Mission	100.8 kg/M^2
Power Loading for Normal Attack Mission	3.4 kg/H.P.

USE OF LOADING CHART

The graphical loading chart shown on pages II - 7 & 8 is for the use of the operator in loading the airplane. The airplane must at all times be loaded in such a manner that the resulting center of gravity position will be within allowable limits as established by flight test. In the succeeding paragraphs, an explanation is given of the procedure followed in the use of this chart.

ALLOWABLE GROSS WEIGHT

The gross weight of the airplane loaded for take-off must first be determined. This is merely a summation of the weight of all of the items involved and should not exceed the maximum recommended gross weight of 7500 lbs. (3401.9) for the attack airplane and 8600 lbs. (3900.8 kg.) for the bomber airplane. The airplane has been designed for an ultimate load factor of 8.5 at a gross weight of 7500 lbs. (3401.9 kg.) and any gross weights above this value will mean a corresponding reduction in load factor. The airplane, gross weight should never be allowed to exceed 9200 lbs. (4173.0 kg.). All of these weights can be obtained directly from the loading chart with the exception of fuel and oil which are determined by the person loading the airplane.

Weight of Fuel = 6.0 lbs./gal. (.719 kg /liter)
Weight of Oil = 7.5 lbs./gal. (.899 kg./liter)

AIRPLANE BALANCE

The balance of the airplane is determined by the relation of the sum of the index units to the corresponding total weight. Index units are merely balance units and are taken directly from the chart. Index units per gallon are shown on the chart for fuel and oil. When loading the airplane, it is the operator's problem to distribute the load in such a manner that the resulting center of gravity position is within the limits of 20% and 33% M.A.C. as shown on the loading chart.

To determine the extreme balance condition of a given load, it is necessary to check the airplane balance both in its most forward center of gravity position and in its most rearward center of gravity position This is necessary because of the center of gravity movement during flight caused by any or all of the following factors:

USE OF LOADING CHART (cont'd.)

1. Consumption of fuel.
2. Dropping of bomb load.
3. Dropping of pyrotechnics.
4. Depletion of gun ammunition.
5. Movement of the gunner between seat and bomber's compartment.

The summation of the weight plotted against the summation of the index units of the items comprising the loaded airplane determines a balance point on the loading chart. If this point falls between the limiting lines the airplane is correctly loaded.

SAMPLE CALCULATIONS

For this example the following loading will be assumed: (Normal Attack)

Item	Weight lbs.	Weight kgs.	Index Units Engl.	Index Units Metric
Weight Empty - L.G. Up	5494	2492.0	51.93	59.82
Pilot & Chute	200	90.7	2.20	2.53
Gunner & Chute (in seat)	200	90.7	3.70	4.26
Fuel(fr.Tanks)-93 gal.(352.01)	558	253.1	6.03	6.93
Oil - 8 gal (30.3 l.)	60	27.2	.37	.42
Flares & Signal Pistol	45	20.4	1.15	1.32
.30 Cal. Fixed guns & amm.(4)	240	108.9	2.18	2.51
Flex. Gun & ammun. (1)	117	53.1	2.45	2.82
Bombs - 20/20 lbs.	400	181.4	5.44	6.27
Radio	179	81.2	2.69	3.10
First Aid Kit	3	1.2	.05	.06
Total	7496	3399.9	78.19	90.04

From the charts the center of gravity is 27% M.A.C.

To check most rearward center of gravity

Above Total	7496	3399.9	78.19	90.04
Less				
Fixed Gun Amm.	130	59.0	1.17	1.35
Gunner in seat	200	90.7	3.70	4.26
Wt. Empty, L.G. Up	5494	2492.0	51.93	59.82
Sub Total	1672	758.2	21.39	24.61

Add				
Gunner in comp't.	200	90.7	4.30	4.95
Wt. Empty, L.G. Down	5494	2492.0	52.06	59.97
Total	7366	3340.9	77.75	89.53

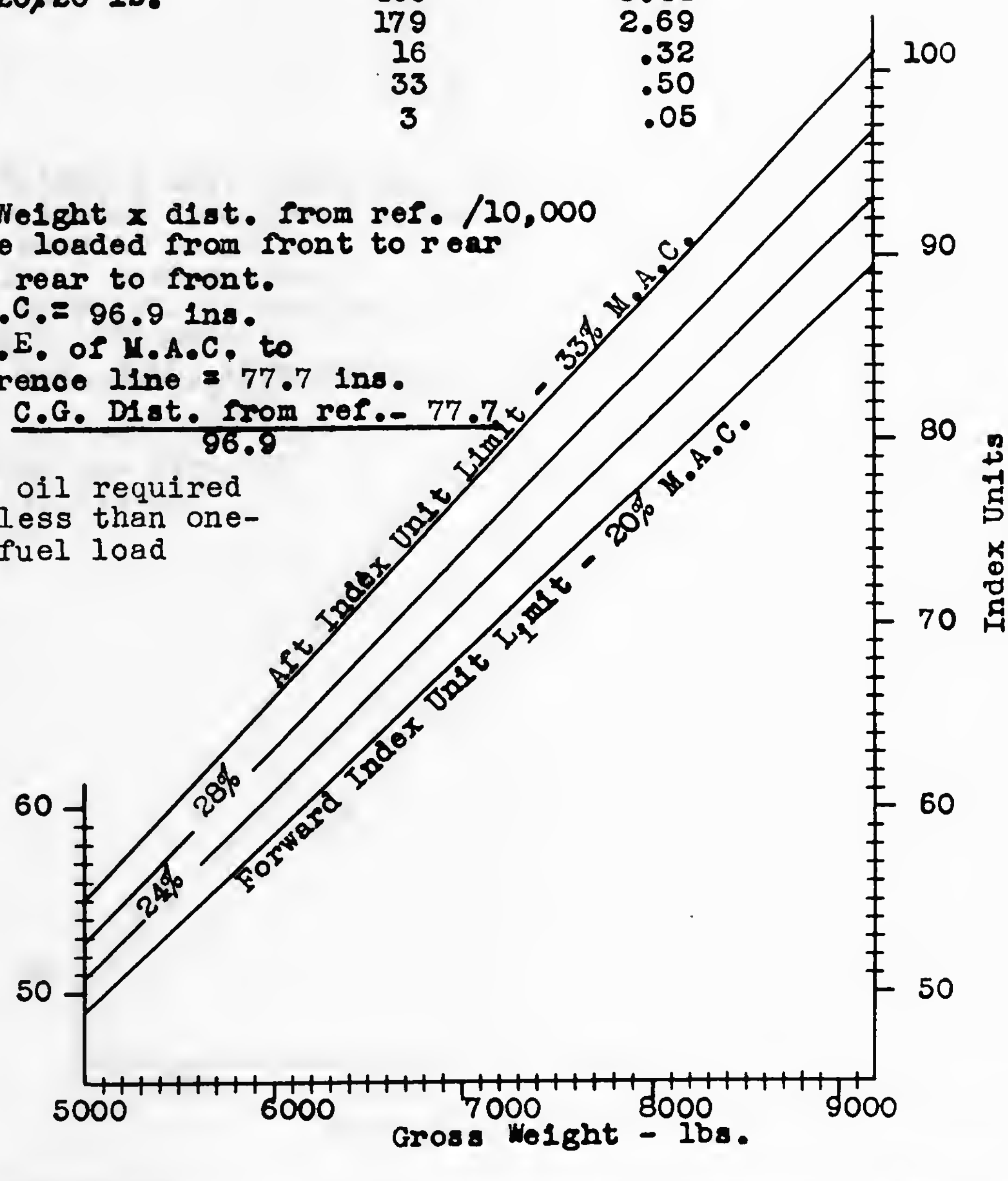
To check most forward center of gravity.

Above Total	7496	3399.9	78.19	90.04
Less				
Fuel - Front Tanks	558	253.1	6.03	6.93
Flares	38	17.2	1.01	1.16
Flex. Gun Amm.	65	29.5	1.34	1.54
Bombs	400	181.4	5.44	6.27
Total	6435	2918.7	64.37	74.14

This loading gives a balance within the allowable limits.

Item	Weight	Index Units
Weight Empty - L.G. Up	5494	51.93
Weight Empty - L.G. Down	5494	52.06
Pilot & Chute	200	2.20
Gunner & Chute in Seat	200	3.70
" in Bomb Compt.	200	4.30
Oil per gal.	7.5	.0457
Fuel per Gal. - Front Tanks	6.0	.0648
" " " - Center "	6.0	.0762
" " " - Rear "	6.0	.0864
Flares & Signal Pistol	45	1.15
Fixed Guns - 30 Cal. (4)	110	1.01
Fixed Guns Ammunition - 30 cal.	130	1.17
Fixed Guns - 50 cal. (2)	190	[redacted] 2.42
Fixed Guns Ammunition - 50 cal.	100	1.24
Flexible Gun (1)	52	1.11
Flexible Gun Ammunition	65	1.34
Bombs - External /50 lb.	50	.62
" - " /100 lb.	100	1.24
" - " /250 lb.	250	3.10
" - Internal 20/20 lb.	400	5.44
Radio Equipment	179	2.69
Bomb Sight	16	.32
Oxygen Equipment	33	.50
First Aid Kit	3	.05

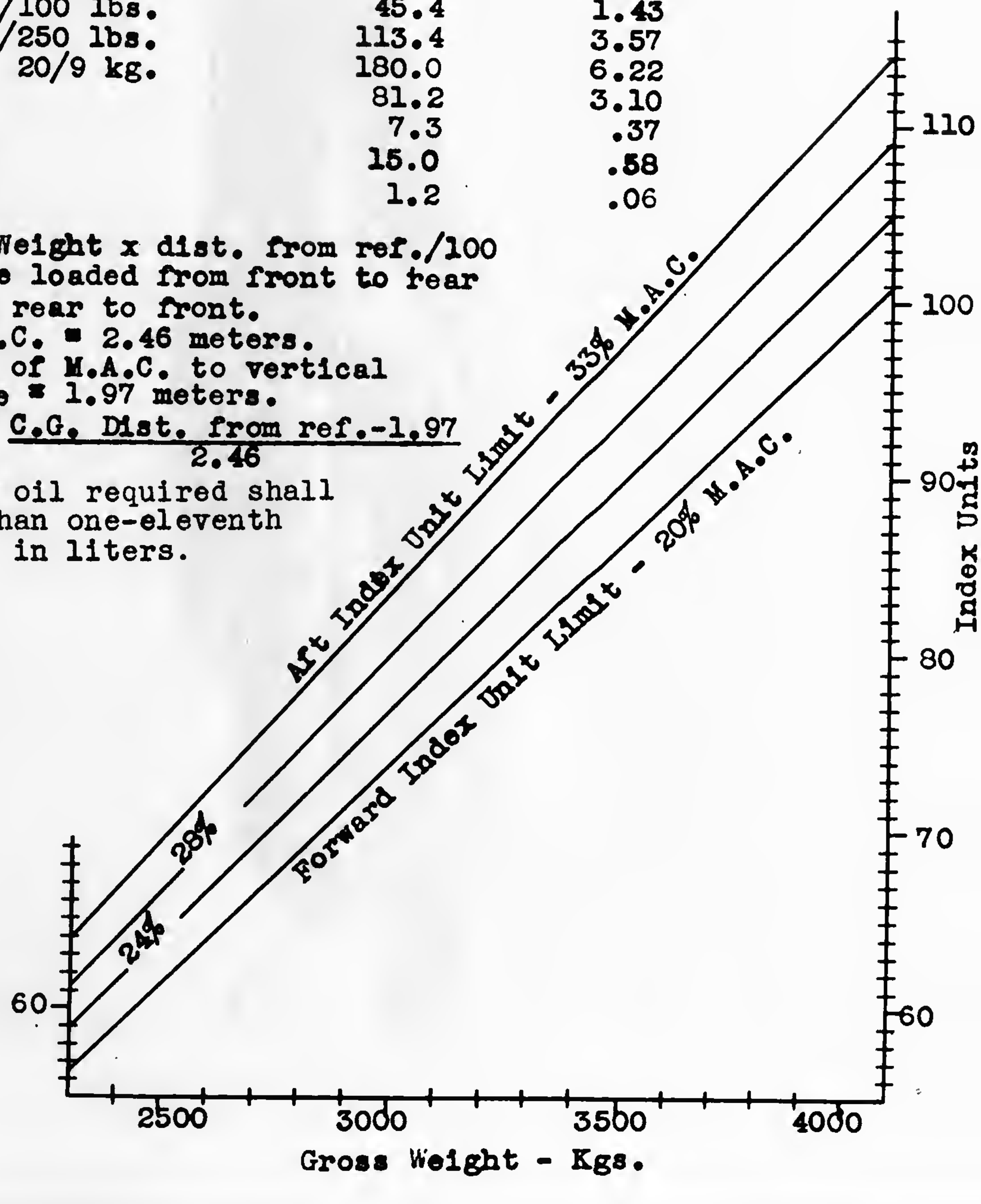
Note:
1. Index Unit = Weight x dist. from ref. /10,000
2. Fuel should be loaded from front to rear and used from rear to front.
3. Length of M.A.C.= 96.9 ins.
4. Distance of L.E. of M.A.C. to vertical reference line = 77.7 ins.
5. $\frac{\text{C.G. (\%MAC)}}{100} = \frac{\text{C.G. Dist. from ref.} - 77.7}{96.9}$
6. The amount of oil required shall be not less than one-eleventh the fuel load in gallons.

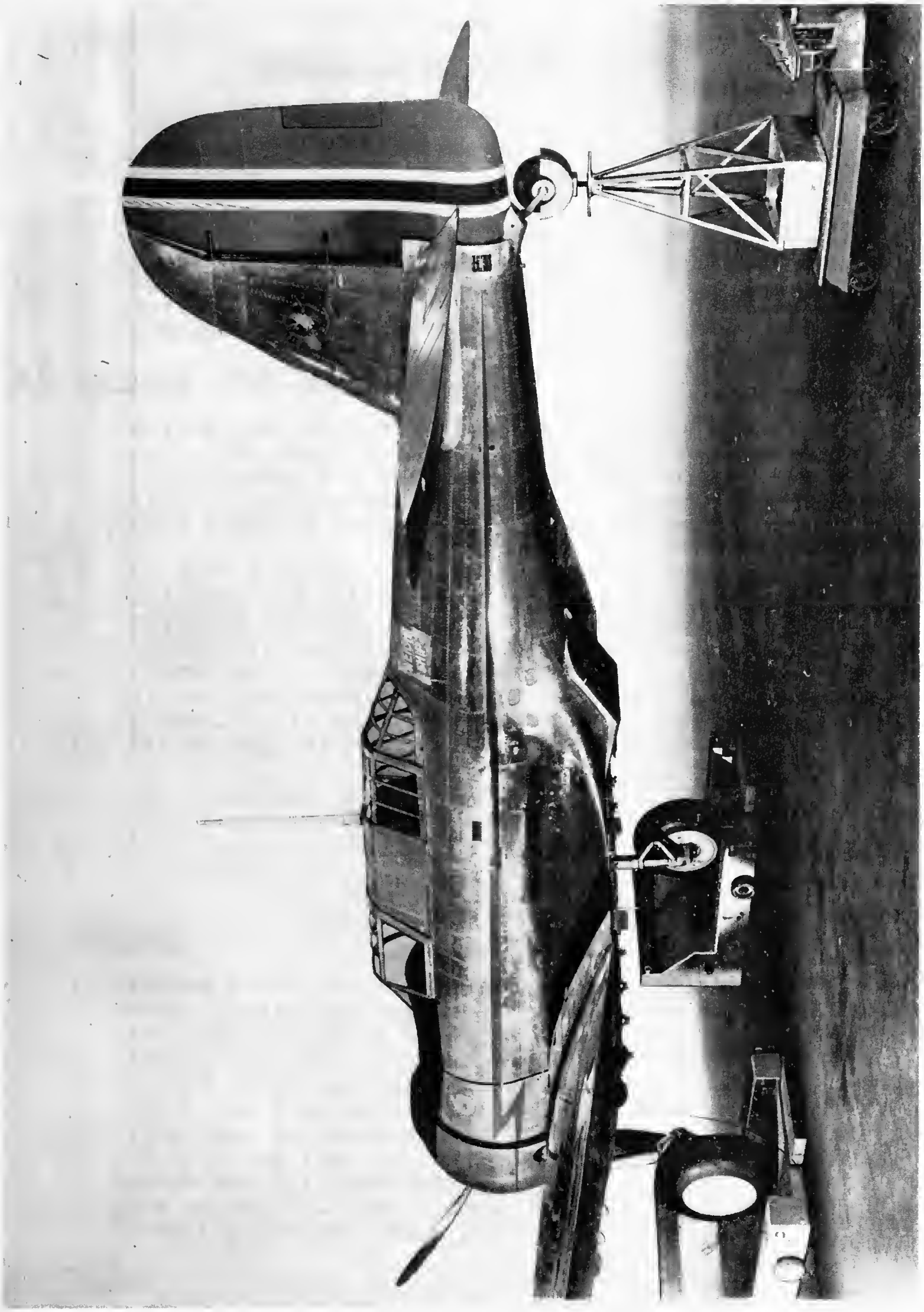


Item	Weight	Index Units
Weight Empty - L.G. Up	2492.0	59.82
Weight Empty - L.G. Down	2492.0	59.97
Pilot & Chute	90.7	2.53
Gunner & Chute in Seat	90.7	4.26
" in Bomb Compt.	90.7	4.95
Oil per Liter	.899	.0139
Fuel per Liter - Front Tanks	.719	.0197
" " " - Center Tanks	.719	.0232
" " " - Rear Tanks	.719	.0263
Flares & Signal Pistol	20.4	1.32
Fixed Guns - 30 cal. (4)	49.9	1.16
Fixed Guns Ammunition - 30 cal.	59.0	1.35
Fixed Guns - 50 cal. (2)	86.2	[redacted] 2.78
Fixed Guns Ammunition - 50 cal.	45.4	1.43
Flexible Gun (1)	23.6	1.28
Flexible Gun Ammunition	29.5	1.54
Bombs - External /50 lbs.	22.7	.71
" " /100 lbs.	45.4	1.43
" " /250 lbs.	113.4	3.57
" Internal 20/9 kg.	180.0	6.22
Radio Equipment	81.2	3.10
Bomb Sight	7.3	.37
Oxygen Equipment	15.0	.58
First Aid Kit	1.2	.06

Note:

1. Index Unit - Weight x dist. from ref./100
2. Fuel should be loaded from front to rear and used from rear to front.
3. Length of M.A.C. = 2.46 meters.
4. Distance L.E. of M.A.C. to vertical reference line = 1.97 meters.
5. $\frac{\text{C.G. (\%MAC)}}{100} = \frac{\text{C.G. Dist. from ref.} - 1.97}{2.46}$
6. The amount of oil required shall be not less than one-eleventh the fuel load in liters.





8241 - Airplane on Scales Being Weighed

SECTION III

GENERAL INSTRUCTIONS

A. ILLUSTRATIONS

1. A complete set of major installation drawings for this airplane is assumed to be available to personnel at repair stations, (see page III - 3) The photographs and diagrams contained in these instructions, although sufficiently complete for minor repair, should be supplemented by the pertinent drawings for a major overhaul.

B. HANDLING (Ref. page III - 6)

1 A jack pad is provided on the lower end of each landing gear oleo strut for use in lifting the wheels. To lift the airplane for servicing the landing gear or its retracting mechanism, jack pads are located in the outer wing about 18 inches (45 cm.) from the attaching angles.

2. To lift the tail, pass a steel bar or tube about 6ft. (2 m.) long and 1 1/8 inch (2.8 cm.) in diameter through the hoisting tube in the fuselage near the leading edge of the horizontal stabilizer. For supporting the tail, a pad is conveniently located on the bottom of the fuselage forward of the tail wheel. If tail is raised to flight position a 100 lb. (45 kg.) weight should be hung on the lifting bar at each side of fuselage as a precautionary measure.

CAUTION: Never lift, pull or push the airplane by the empennage assembly. Use a spreader bar between the landing wheels, to prevent accidental folding of landing gear and when airplane is to be in storage.

C. HOISTING

1. Tapped holes for the insertion of hoisting lugs are located in the top surface of the center section. When the lugs are to be used, be sure they are screwed in as far as they will go. In addition to the lines attached to the hoisting lugs, a line must be attached to a bar which has been passed through the tail hoisting tube. This line is necessary to balance the airplane. A pair of hoisting lugs is furnished with each airplane. Do not under any circumstances hoist the airplane by means of the engine hoisting sling. See Tie-down, Towing and Handling Diagram, Page III - 6.

D. TOWING

1. Towing rings are located at the lower end of each landing gear oleo strut. DO NOT TOW FROM ANY OTHER POINT.

E. LEVELING

1. The airplane may be leveled longitudinally by holding a spirit level against the fuselage centerline skin seam. Lateral leveling may be accomplished by holding the level on either the top or bottom of the center section.

2. The center of gravity can readily be determined for various conditions of loading by placing a scale under each point of support with the airplane level

F. FILLING FUEL & OIL TANKS

1. Fuel

(a) There are six wing tanks which must be filled separately. Filler caps are located on the upper side of the center section, near the fuselage. Reserve fuel is carried in the left hand front tank. See page X - 2, for capacities.

2. Oil

(a) The oil tank is located on the engine mount just forward of the firewall. The filler neck, located on the left side of the fuselage, is accessible through a hinged cover plate on the cowling. See page XI - 1, for capacity.

G. STEPS & WALKWAYS

1. Steps

(a) Retractable steps are located on the left side of the fuselage to facilitate entering the gunner's cockpit The front cockpit is easily accessible from the top of the center section.

2. Walkways

(a) Walkways are provided on the top of the wing center section adjacent to the fuselage. Walkways are made of a carborundum composition and are painted black.

H. LASHING DOWN

1. A tie ring is located in the wing structure at each wing tip. The ring is accessible through a suitably marked hinged cover plate located on the under side of the tip The tail of the fuselage may be lashed down by means of the tail wheels.

LIST OF DRAWINGS OF MAJOR INSTALLATIONS FURNISHED WITH 8A-5 AIRPLANE

NUMBER	NOMENCLATURE
5091100	General Assembly
5066001	Installation - Wings
5091102 & -1	Wing Assembly - Left and Right
5053427 & -1	Installation - L. & R. Wing Attaching Angle
2056603 & -1	Aileron Assembly - Left and Right Covered
580303 & -1	Frame Assembly - Left and Right Aileron
4056604 & -1	Cover Assembly - Left and Right Aileron
3063918 & -1	Tab Assembly - Left and Right Aileron
561505 & -1	Flap Assembly - Left and Right Wing
5056605 & -1	Tip Assembly - Left and Right Wing
5091106	Plan Insignia and Marking
5066007	Installation - Empennage
5056608 & -1	Stabilizer Assembly - Left and Right Horizontal
2056609 & -1	Elevator Assembly - Left and Right Complete
577783 & -1	Frame Assembly - Left and Right Elevator
4056610 & -1	Cover Assembly - Left and Right Elevator
577991 & -1	Tab Assembly - Left and Right Elevator
5056611	Stabilizer Assembly - Vertical
4056612	Rudder Assembly - Complete
577742	Frame Assembly - Rudder
4056613	Cover Assembly - Rudder
577965	Flap Assembly - Rudder
2091114	Structure Assembly - Fuselage Complete
5066015	Structure Assembly - Fuselage
5066016	Wing Assembly - Center Section
561430	Flap Assembly - Center Section
4056617	Installation - Tail Wheel
5056618	Installation - Wheel Type Landing Gear
583768 & -1	Actuating Assembly - Landing Gear
582050 & -1	Installation - Landing Gear Fairing
5091119	Installation - Demountable Power Plant
5091560	Mount Assembly - Engine
12-758	Ring Assembly - Exhaust Collector
5091121	Cowling Assembly - Anti Drag
5091122	Cowling Assembly - Engine Accessory
5091127	Installation - Oil System
5091128	Tank Assembly - Oil
5091146	Installation - Power Plant Section Fuel System
5091147	Installation - Power Plant Section Electrical
5091148	Installation - Power Plant Section Instruments

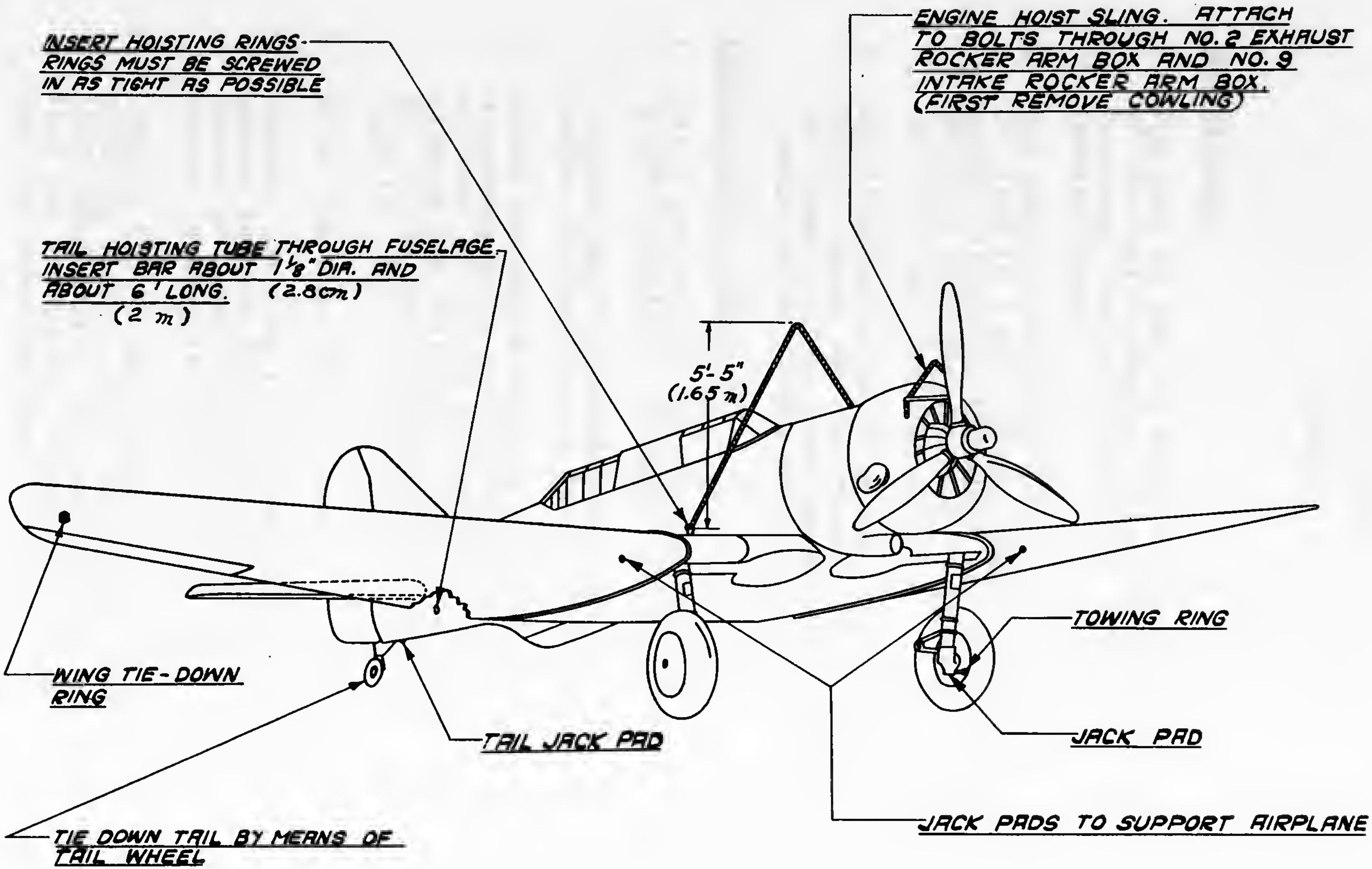
LIST OF DRAWINGS OF MAJOR INSTALLATIONS FURNISHED WITH 8A-5 AIRPLANE

NUMBER	NOMENCLATURE
5091519	Installation - Power Plant Section Fire Extinguisher
5091558	Installation - Power Plant Section Heating System
5091150	Installation - Power Plant Section Engine and Propeller Controls
5091123	Installation - Fuselage Section Fuel System
579130	Tank - Front Fuel
5056625	Tank - Center Fuel
579010	Tank - Rear Fuel
5091129	Installation - Furnishings
587935-501	Enclosure Assembly - Rear Cockpit
578186	Enclosure Assembly - Center Cockpit
589858	Enclosure Assembly - Front Cockpit
5066005-500	Pedestal Assembly - Control
5059426	Seat Assembly - Pilot's
5091501	Firewall Assembly
5060500	Installation - Rear Cockpit Instrument Panel Brackets
5091131	Installation - Photographic Equipment
5091556	Installation - Oxygen Equipment
5066043	Installation - Bomber's Compartment
588849-500	Floor Assembly - Pilot's
5091502	Cover - Engine
5091503	Cover - Propeller
5091132	Installation - Electrical Equipment (less radio)
5091133	Installation - Radio
5056634-500	Installation - Flight Controls
5091151	Installation - Fuselage Section Engine & Propeller Controls
5091135	Installation - Hydraulic Controls
5091136	Installation - Fuselage Section Instruments
5091137	Installation - Bombing Equipment
5066017-500	Installation - Estopy Bomb Sight
5059433-501	Racks Assembly - 30 lb. Internal Bomb
5091138	Installation - Fuel Line & Bomb Fairing
5091139	Installation - Fixed Gun
5091140	Installation - Flexible Gun
5053043-501	Track Assembly - Gunner's Seat and Gun
5066044	Installation - Type A3 Flare
5066042-500	Installation - Landing Gear Latch Control

LIST OF DRAWINGS OF MAJOR INSTALLATIONS FURNISHED

WITH 8A-5 AIRPLANE

NUMBER	NOMENCLATURE
5091101	Installation - Signal Pistol & Cartridge
5091520	Installation - Fuselage Section Fire Extinguisher
5091559	Installation - Fixed 50 Cal. Gun
5091557	Installation - 50 Cal. Gun Charging Controls
5091555	Installation - 50 Cal. Gun Combat Fairing
5091554	Installation - 50 Cal. Gun Practice Fairing
5091553	Installation - 50 Cal. Gun Mount Supports



TIE-DOWN, TOWING AND HANDLING DIAGRAM

SECTION IV

WINGS

A. DESCRIPTION

1. The wing is the low wing cantilever type and consists of the center section, which is built integral with the fuselage; the two wings; wing tips; the ailerons and the landing flaps.

2. The wings are rigidly bolted to the center section with 1/4 inch (6.3 mm.) nickel steel bolts through attaching angles riveted to the wings and to the center section. The wing tips are attached to the wings by nickel steel 1/8 inch (3.1 mm.) machine screws.

3. The ailerons are of aluminum alloy frame construction, fabric covered and are dynamically balanced. The ailerons are hinged on ball bearings mounted in aluminum alloy forging bolted to the wing structure.

B. INSTALLATION - WING

1. Raise the tail so that the airplane is in approximately a level position. Support the tail in this position.

2. Operate the flap mechanism in the cockpit so that the center section flap is in the full down position

3. Place the wing attaching bulkhead on the center section attaching angle and line up the holes at the edge with at least 10 of the 1/4 inch (6.3 mm.) bolts Place and tighten the bolts with elastic stop nuts to webs #1 and #2, to the brace bracket at web #2, and to web #6, see page IV - 8.

4. Place the wing flap in the full down position.

5. Support the wing in the proper position and bolt to the center section with 1/4 inch (6.3 mm.) nickel steel bolts. Secure at least 10 bolts on the top and 2 on the bottom before leaving the wing unsupported.

6. Connect the aileron cables, electrical wiring, gun charging cables, pitot tubes and cockpit cold air tubes (left wing only), and flap control rods. All except the last are accessible through the handholes in the wing near the attaching angle.

7. For adjustment of aileron cables and flap control rods see page XX - 4.

8. Clip the hook on one end of the attaching angle fairing over the bolt of the attaching angle nearest the trailing edge on the lower surface. Connect the other end of the fairing to the tightening bolt at the upper surface of the trailing edge and secure.

C. ALIGNMENT

1. The center section is built integral with the fuselage and needs no adjustment.

2. The wings are rigidly bolted to the center section and are properly aligned as assembled. They require no adjustment.

D. TO REMOVE AILERONS

1 Disconnect the aileron actuating rods by removing the bolts through the aileron horns. These are accessible on the upper side of the ailerons.

2 Disconnect the tab actuating rods and aileron hinge bonding strips.

3 Remove the bolts from the three aileron hinges and lift the aileron out.

E. TO REMOVE THE WINGS

1. Pump flaps to the full down position.

2. Remove the fairing from around the attaching angle.

3 Disconnect the flap rod universal by removing the bolt at the end of the center section actuating rod.

4. Disconnect the electrical wiring, the aileron cables and the gun charging cables. Then the pitot tubes, which are in the left wing only.

5. Remove all except two of the bolts on the lower side of the wing, and all except 10 equally spaced bolts on the upper side of the wing.

6. Support the wing so that the wing attaching angle will remain squared against the center section attaching angle while the remainder of the bolts are being removed.

7. Remove the wing by pulling straight out until all lines are clear.

F. TO REMOVE THE LANDING FLAPS

1. Disconnect all bonding strips.

2. Disconnect the linkage at the flap eye bolts by removing the nickel steel bolts (It is not necessary to remove the forked links at the actuating tube ends).

3. Remove the hinge pins and pull flaps off.

G. MAINTENANCE & REPAIR

1. If it becomes necessary to repair skin surfaces or concealed parts, and hand holes need be cut, first refer to drawings on pages IV - 6 and IV - 7. Existing hand holes and marked positions for additional hand holes are shown. Exact list of materials can be compiled for minor repairs from this drawing. Changes in weight or thickness of materials are also shown or noted, therefore, reasonable repairs can be readily made.

2. Walkways: In case any portion of the roughened surface of the walkway on the wings becomes worn smooth, the original surface may be restored as follows:

(a) Clean down to bare metal with paint solvent to prepare a surface that is absolutely clean, dry and free from grease.

(b) Mask out surfaces adjacent to areas to be repaired.

(c) Apply one coat zinc chromate primer and allow to dry the full time stipulated by the manufacturer.

(d) Apply one heavy brush coat of unthinned "Plyosyn" and sprinkle immediately, while wet, with a coating of powdered carborundum, #30 mesh grit. Sprinkling may be done by hand or with some sort of improvised shaker.

(e) Allow two hours to dry.

(f) Remove surplus carborundum with low pressure air hose or vacuum cleaner.

(g) Apply one brush coat of 25 per cent thinned "Plyosyn", using thinner recommended by manufacturer.

(h) Do not use walkways for at least 24 hours after completion.

3. Watertighting

(a) The watertight Compartments in each wing are:

1. Leading edge to web #1, from bulkhead #2 1/2 to bulkhead #10, except landing lights cutout.

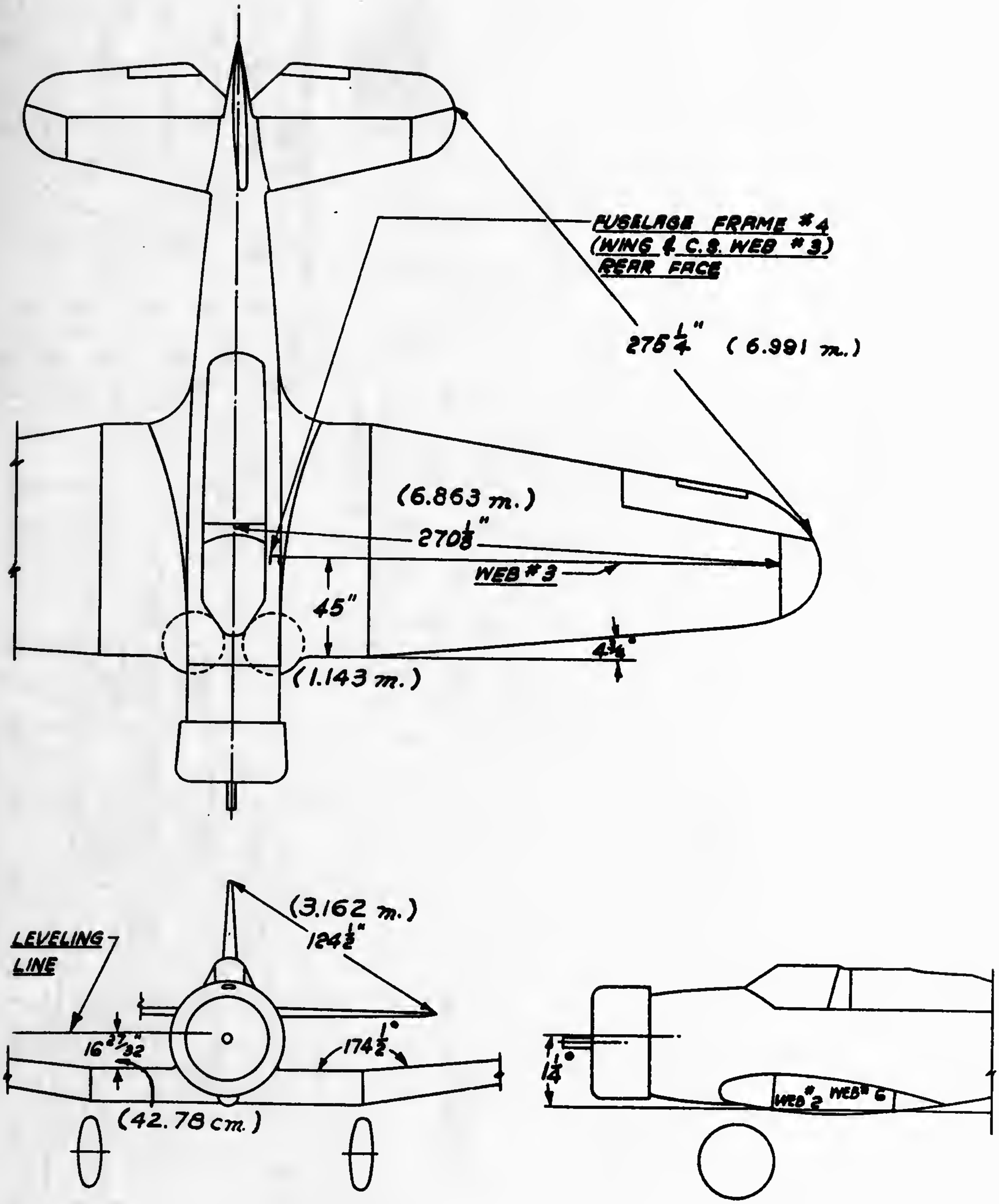
2. Web #1 to web #3, from bulkhead #3 to bulkhead #10.

3. Web #3 to web #4, from bulkhead #4 to bulkhead #10.

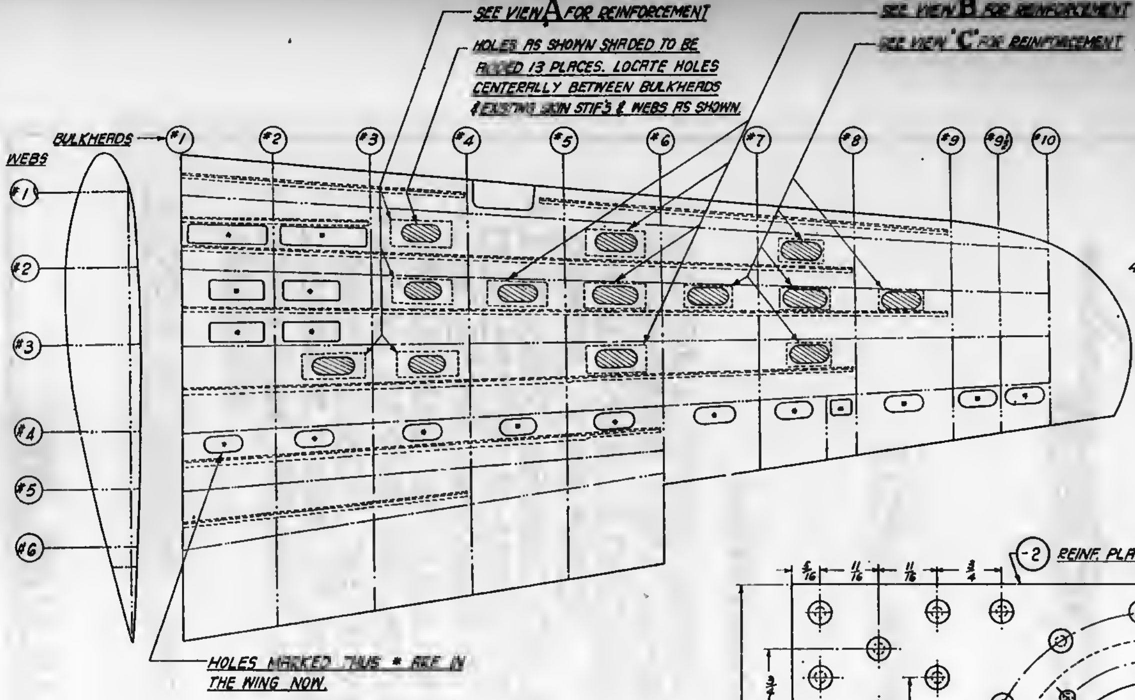
(b) See page XXV - 14 for materials used and locations of watertighting in the event repairs to wing structure are necessary.

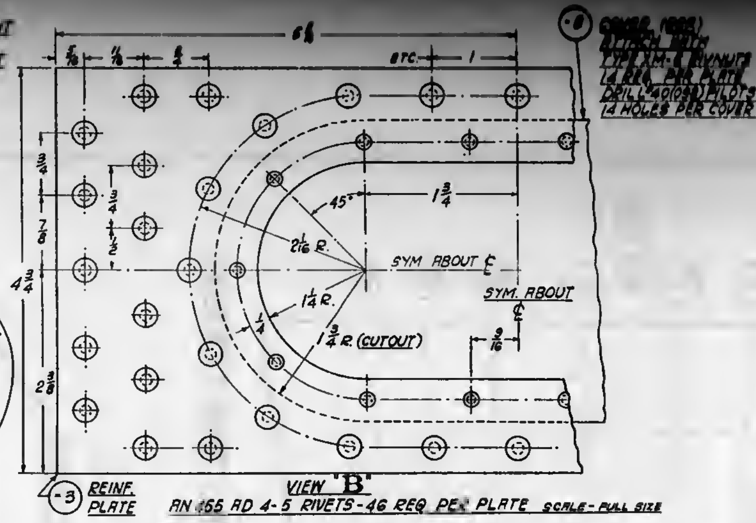
4. For additional information see Section XXIII.

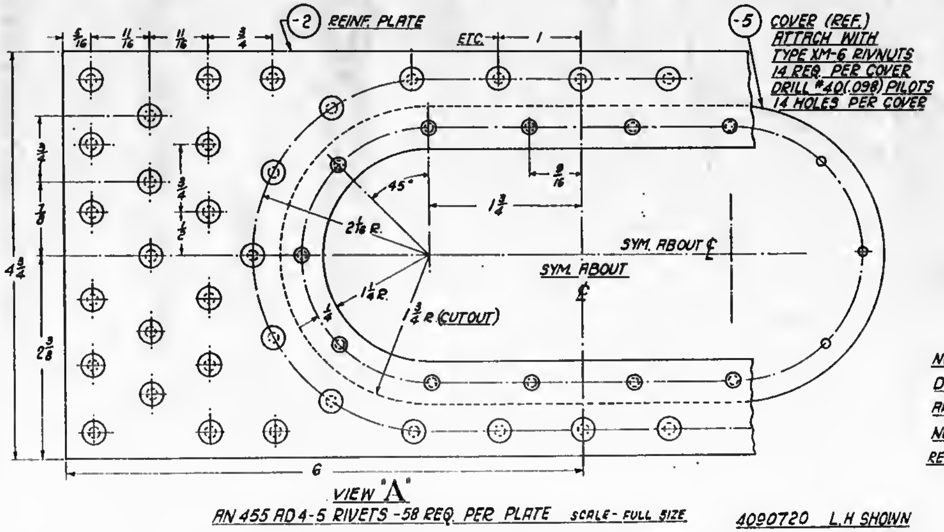
5. Should it become necessary to rebuild a damaged wing, center section or empennage, the dimensions should conform to those on page IV - 5.

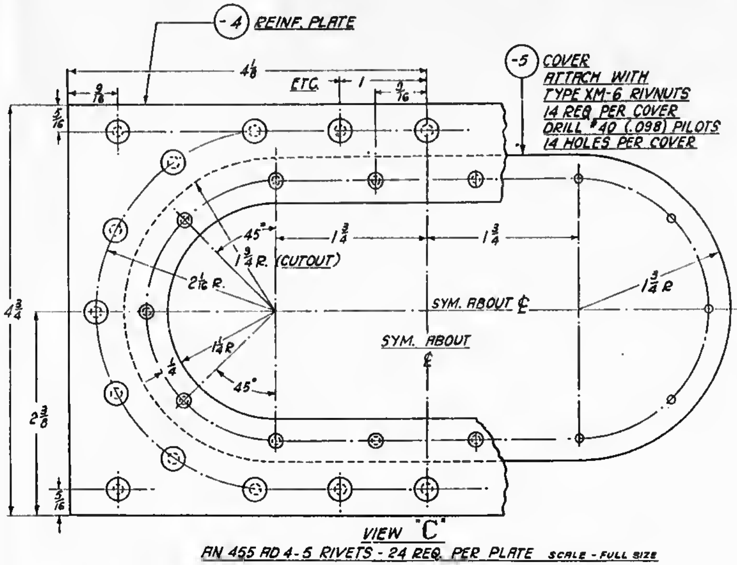


RIGGING DIAGRAM
MODEL 8 A-5









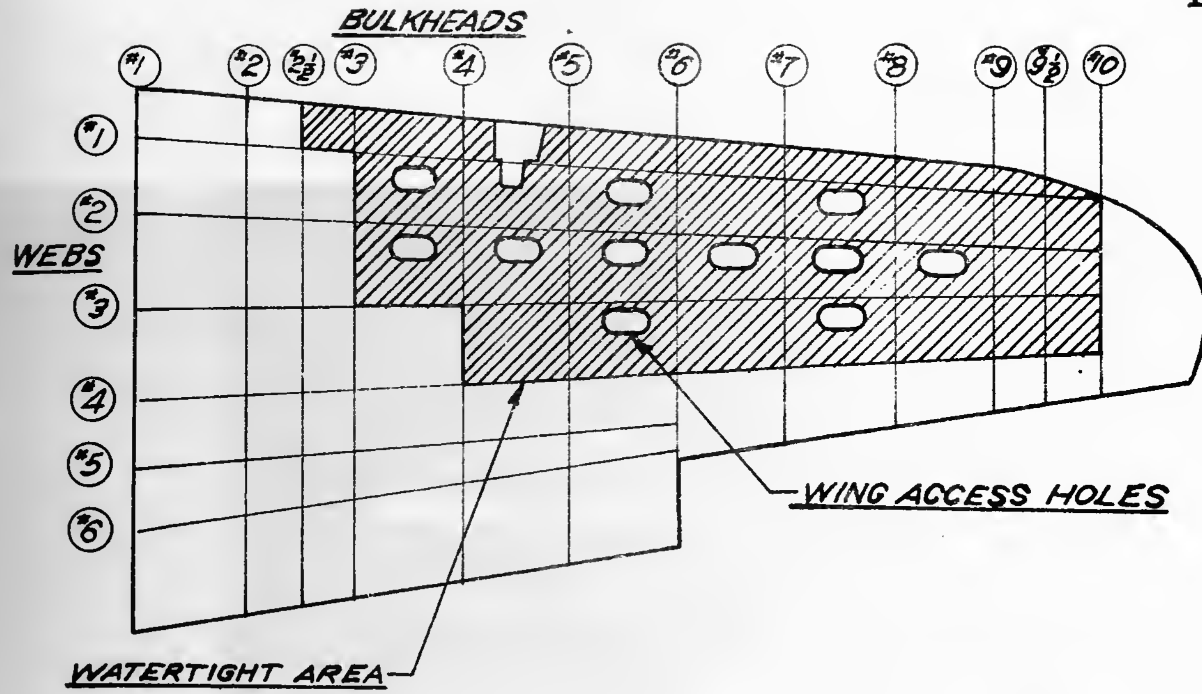
NOTE :-
1. DRILL # 30 (.128) FOR AN 455 AD 4 RIVETS
2. DRILL # 10 (.193) FOR XM-6 RIVNUTS
3. SEAL HAND HOLES WITH NEOPRENE CEMENT APPLIED TO BOTH COVER & REINF. & DIPPING THE RIVNUTS IN THE CEMENT BEFORE RIVETING
4. WHERE RIVETING IS IMPRACTICABLE, A #8-32 SCREW & ELASTIC STOP NUT MAY BE SUBSTITUTED.
5. MIN. EDGE DISTANCE ON AN 455 D4 RIVETS TO BE 1/4" FOR .040 OR LESS
6. THESE HAND HOLES TO BE USED ONLY WHERE NECESSARY FOR REPAIR WORK.

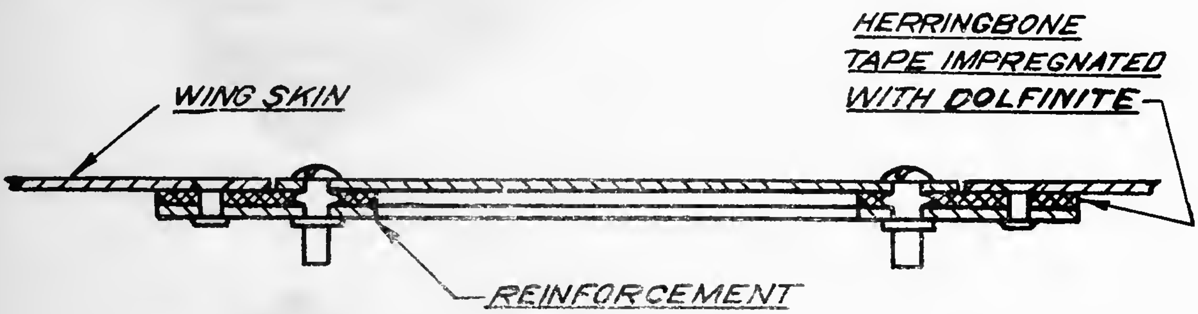
NOTE :-
DASH NUMBERED PARTS ARE IDENTICAL TO DASH NUMBERS
REF. #5050397 L.H. SHOWN
#5050397-1 R.H. OPPOSITE

4090720 L.H. SHOWN
4090720-1 R.H. OPPOSITE

R.H.	L.H.	NO REQ	SIZE	DESCRIPTION	ARMY	NAVY
	-5	13	3 1/8 S.W. x 7 S L	.032 SHEET ALUM ALLOY 24 ST AL OR EQ	A.C. 11067 TYPE II	47-A-8 COND "T"
	-4	5	NOTED x 8 1/2 S L	.040 SHEET ALUM. ALLOY 24 ST AL OR EQ	A.C. 11067 TYPE II	47-A-8 COND "T"
	-3	4	NOTED x 10 5/8 S.L.	.040 SHEET ALUM. ALLOY 24 ST AL OR EQ	A.C. 11067 TYPE II	47-A-8 COND. "T"
	-2	4	NOTED x 12 S L.	.040 SHEET ALUM ALLOY 24 ST AL OR EQ	A.C. 11067 TYPE II	47-A-8 COND "T"
DASH NO			MATERIAL		MATERIAL SPECIFICATION	

OUTER WING ACCESS HOLES





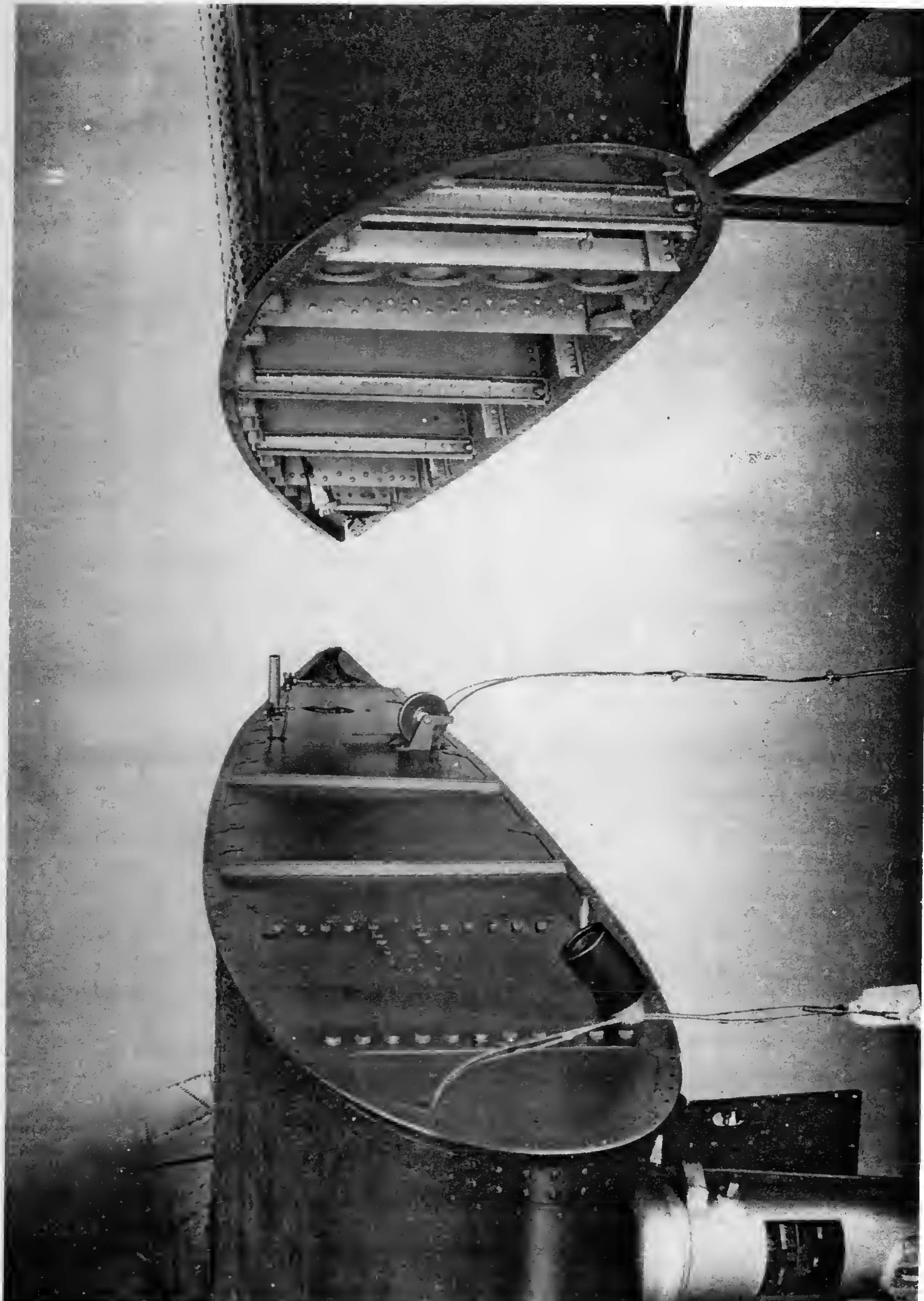
TYPICAL SECTION OF WING ACCESS HOLES

WATERTIGHTING OF WINGS

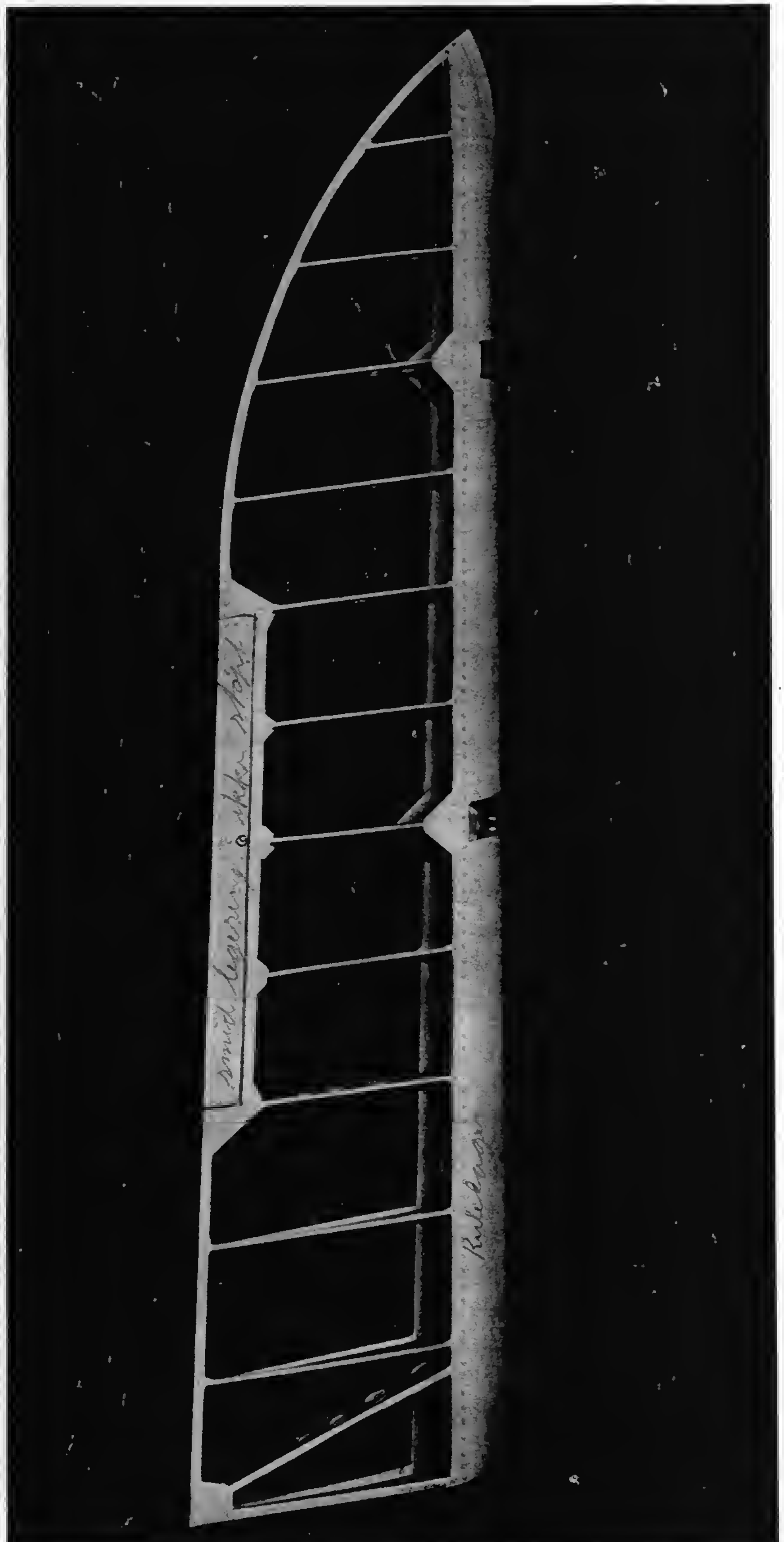
1. INTERNAL FAYING SURFACES SHOULD BE ASSEMBLED WITH HERRINGBONE TAPE IMPREGNATED WITH DOLFINITE.
2. THE INTERNAL STIFFENERS SHOULD BE PLUGGED WITH CORK DIPPED IN DOLFINITE.
3. THE JOINT AROUND THE STIFFENERS SHOULD BE FITTED WITH CANTON FLANNEL PATCH SEALED WITH DOLFINITE.
4. THE FAYING SURFACES OF EXTERNAL JOINTS SHOULD BE ASSEMBLED WITH DOLFINITE IMPREGNATED TAPE BETWEEN LAPS.
5. ON ALL SEAMS AND PATCHES APPLY A HEAVY COAT OF SPAR VARNISH OVER THE COMPLETE JOINT AFTER THE PRIMER OR LACQUER TOUCH UP HAS BEEN MADE. THE EXCESS DOLFINITE SHOULD BE REMOVED BEFORE THE APPLICATION OF THE VARNISH.

REFER TO DOUGLAS DWG. 5091102

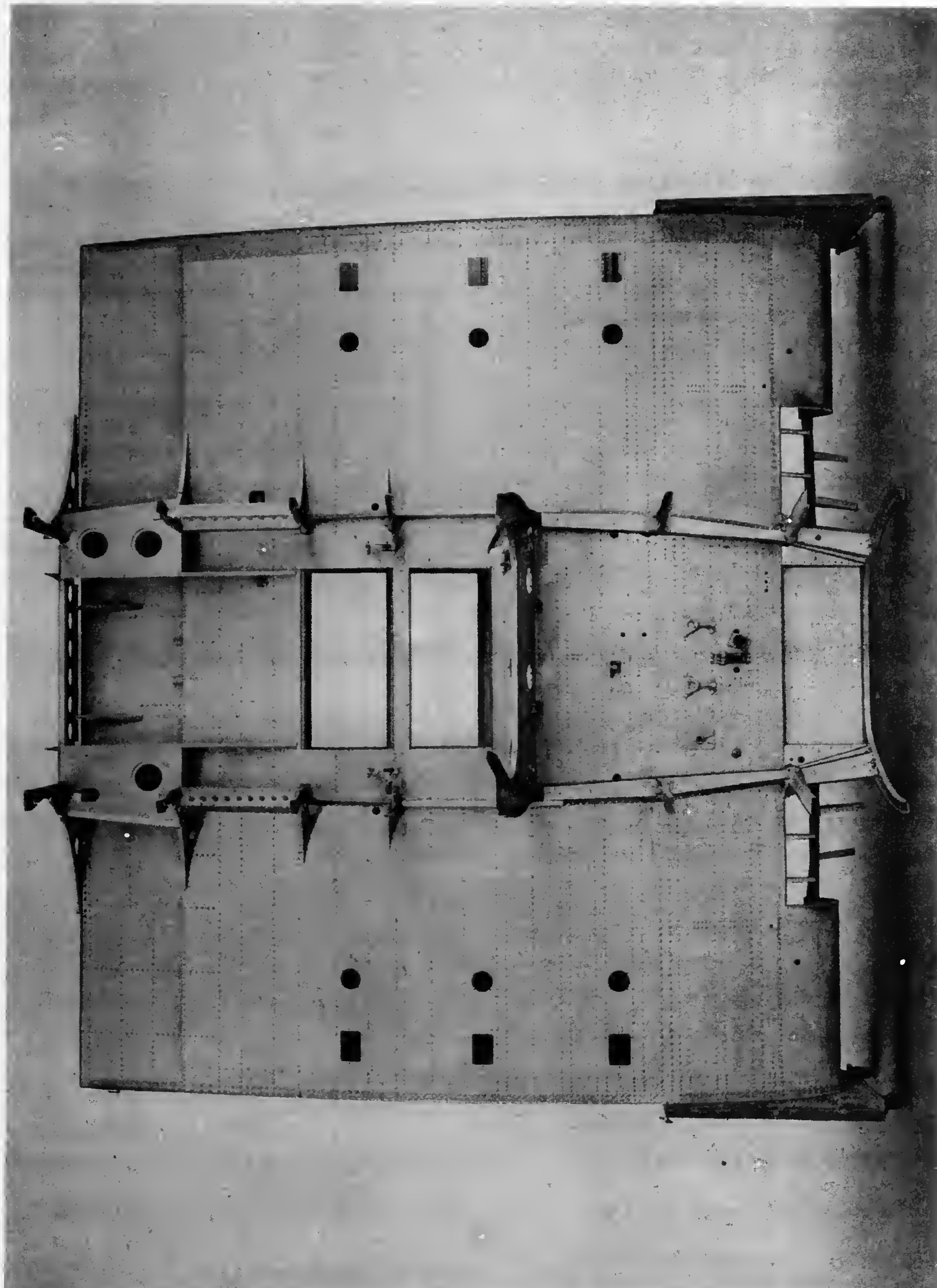
WING WATERTIGHT COMPARTMENT



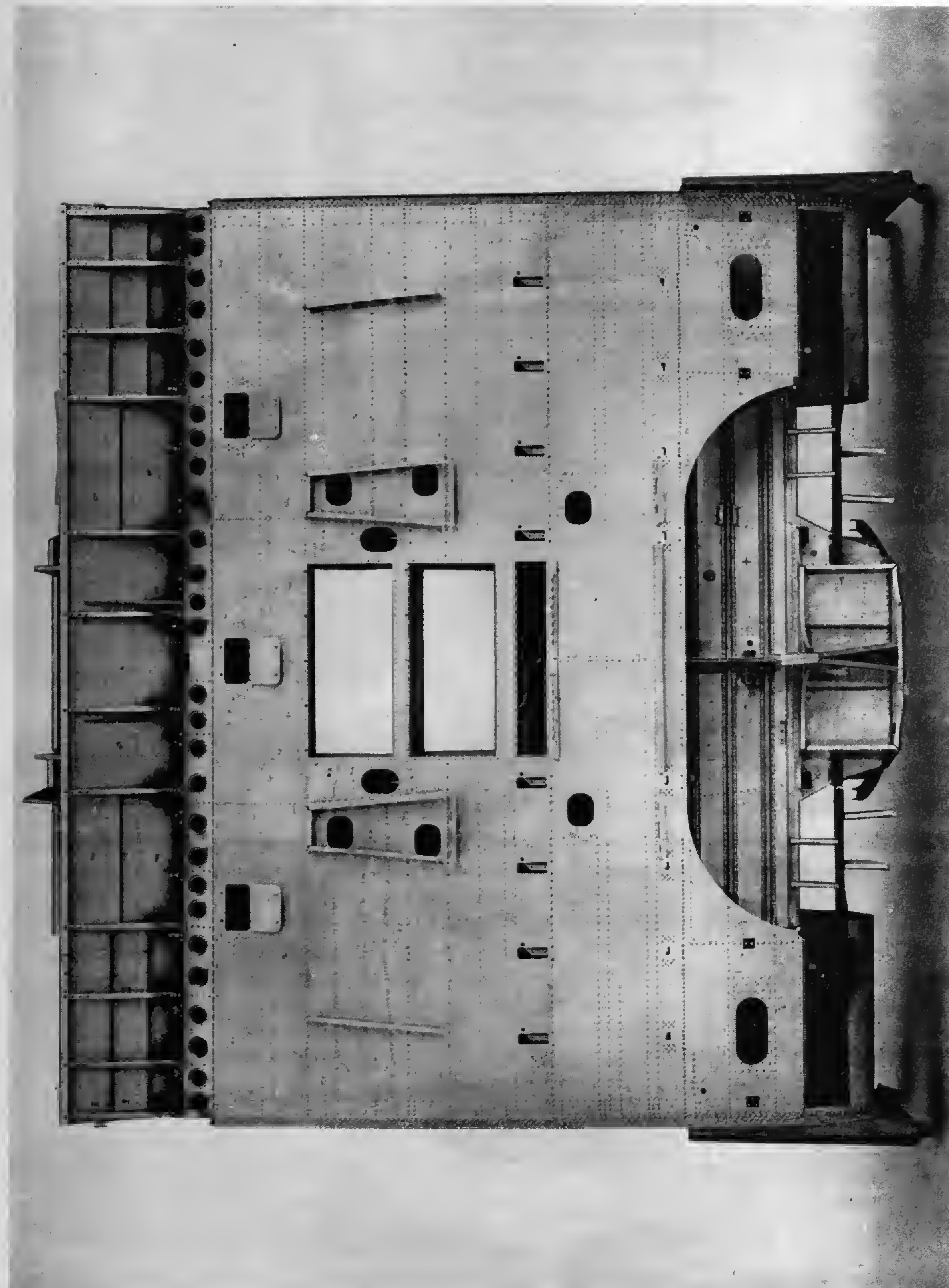
5460 Wing Being Attached to Center Section



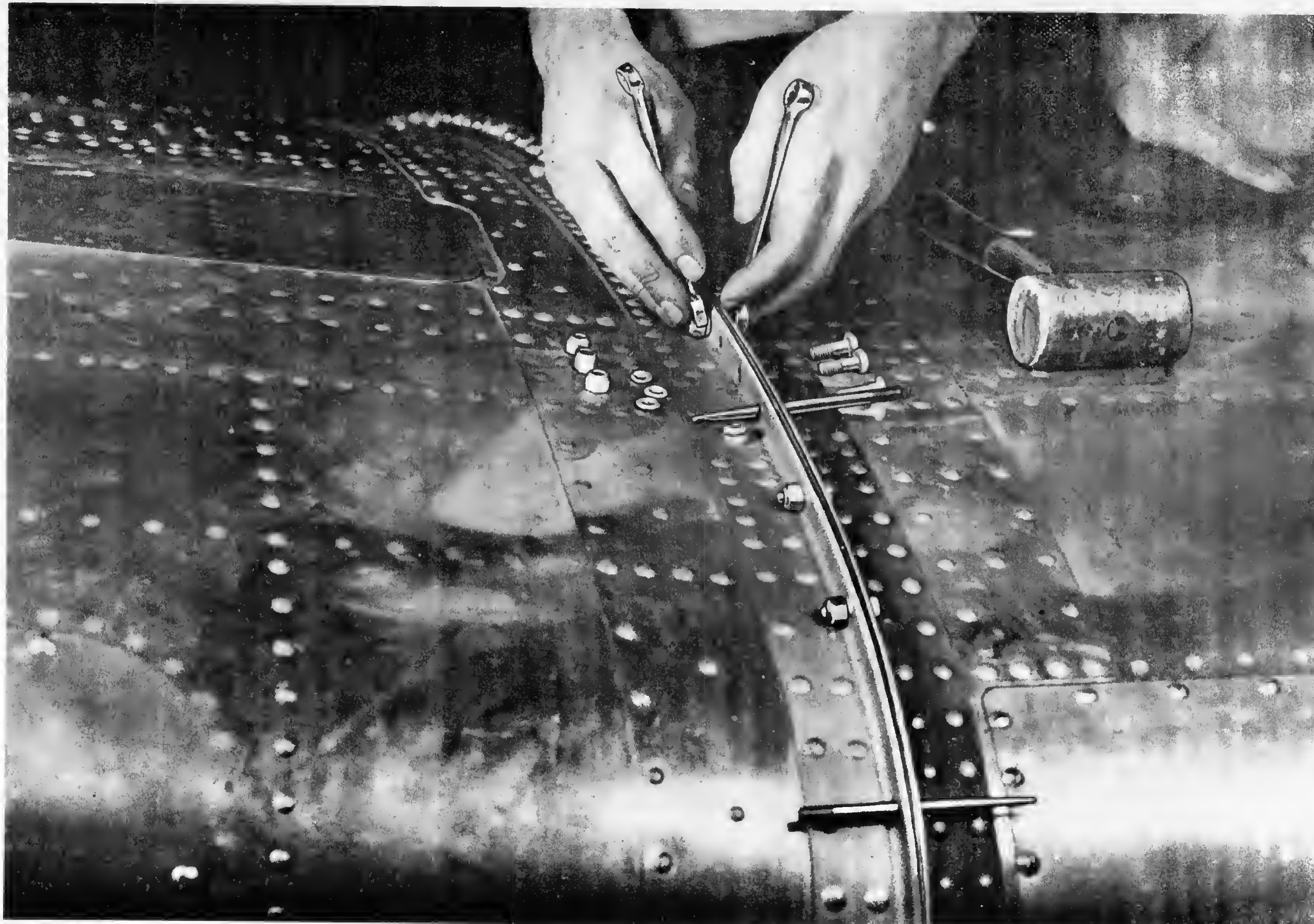
2674 - Aileron Frame Assembly



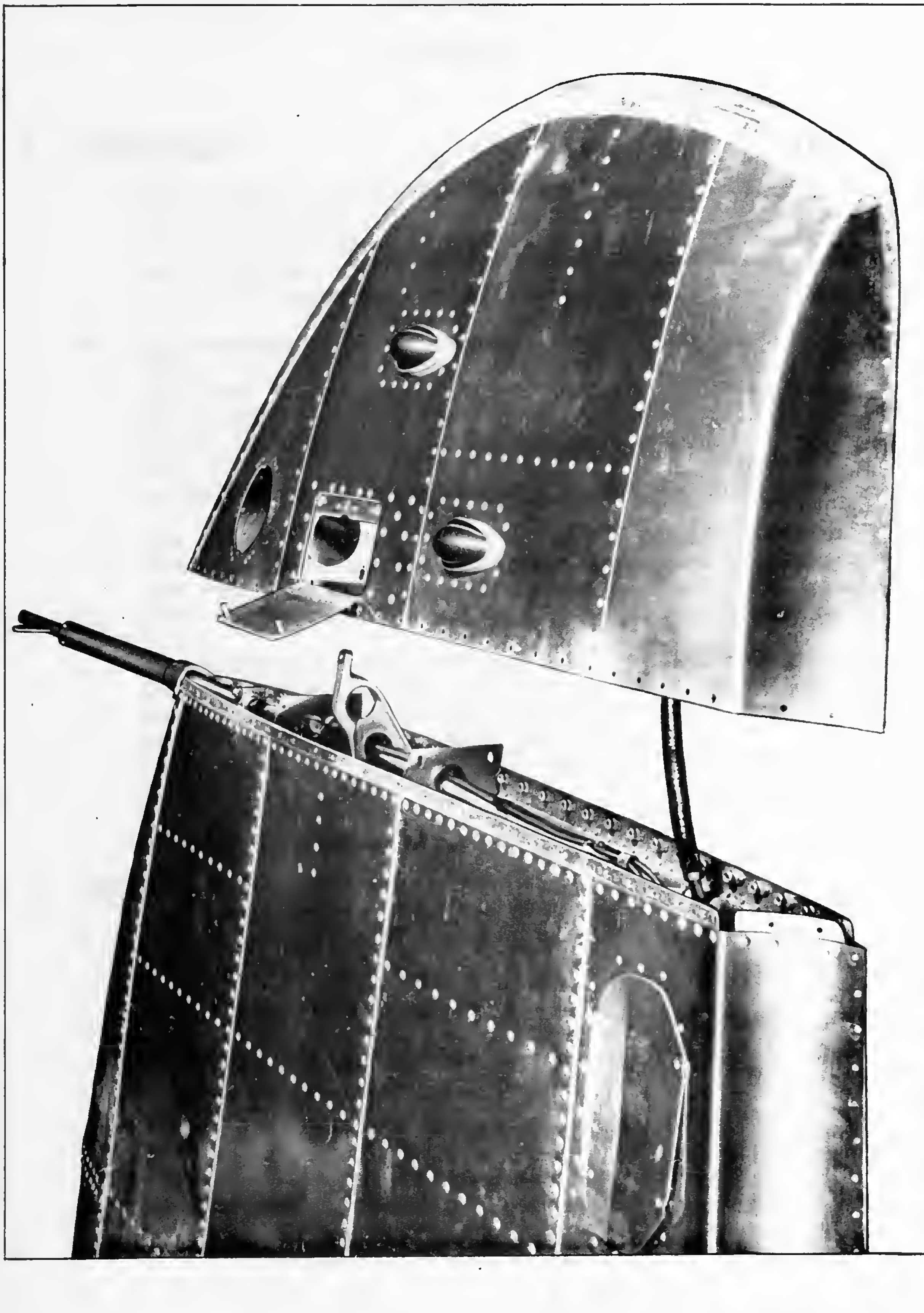
5080 - Center Section Assembly - Top



5081 - Center Section Assembly - Bottom



8224 - Bolting Wing To Center Section



8290 - Tip Being Attached to Wing

SECTION V

EMPENNAGE

A. DESCRIPTION

1. The vertical stabilizer is a full cantilever unit attached rigidly to the fuselage. It is constructed of a riveted alclad frame covered with a smooth alclad skin riveted to the frame. It is permanently set at a 2 1/2° angle to the left.

2. The horizontal stabilizer is also a full cantilever unit. It is constructed in the same manner as the vertical stabilizer except that it is made in two halves which are held together by bolts through an attaching angle riveted to the upper and lower skin. This unit must not be divided for assembly or disassembly. It is permanently set at a negative 1/2° angle.

3. The rudder and elevators are made of a riveted alclad frame, fabric covered. The extreme lower portion of the rudder completes the fuselage fairing and is covered with smooth alclad sheets.

4. In addition to the conventional empennage control surfaces, controllable trim tabs are fitted to the movable surfaces. Those on the elevators serve for longitudinal trim, and the tab on the rudder for directional trim of the airplane. They are all metal units hinged to the rudder and elevators on steel bushed dural bearings. The tabs are manually controlled, individually, from one control unit in the pilot's cockpit.

B. INSTALLATION (Ref. Section VII, B, and Section XX)

1. Install the horizontal stabilizer by bolting through the brackets to frame #14 1/2 and #15 and bolting the attaching flanges to the skin.

2. Attach the vertical stabilizer by bolting the forward fitting to frame #14 1/2 only. For tail light wiring connection see Section XXI, B.

3. Place the tail casting and the spacers in position and bolt through. This casting ties the horizontal and vertical stabilizers rigidly to the fuselage.

   NOTE: The spacers assemble between the horizontal and vertical stabilizer closing channels.

4. Insert the long section of each tab operating tube through the holes provided in the horizontal and vertical stabilizers. Attach the forward ends of the tubes to their respective drums inside the fuselage.

5. Assemble the elevator horn casting to the tail casting.

6. Attach the elevator hinge bearings to the stabilizer. The hinge bearings are assembled to the elevator at the factory.

7. Attach the tail wheel assembly to the casting and brackets provided. See Section VII, B for complete instructions.

8. Assemble the elevator horn casting to the elevators, and connect the bonding strip.

9. Attach the elevator control cables to the elevator horns and attach the tab controls tubes at the elevator hinge line.

10. Attach the rudder bearing brackets to the vertical stabilizer and to the tail casting.

11. Attach the rudder cables to the rudder. See Section XX, B.

12. Attach the rudder tab operating tube at the hinge center line.

13. Attach the tail wheel steering pulley swivel to the support bracket on the yoke and attach the cables to the steering horn.

14. For control surface cable adjustments see Section XX, B.

15. Attach the horizontal and vertical stabilizer fairings, rudder fairing, and the tail wheel fairing with the machine screws provided.

C. TO REMOVE RUDDER

1. Remove the rudder fairing.

2. Disconnect the rudder tab operating tube by removing the two small taper pins just forward of the universal joint. See (A) , page V - 5.

3. Disconnect the rudder control cables at the rudder.

4. Remove the bolts that attach the two hinge bearing brackets to the vertical stabilizer and the two bolts that attach the lower bearing bracket to the tail casting.

D. TO REMOVE RUDDER TAB & TAB OPERATING TUBE

1. Remove the two hinge bolts and pull the tab straight out.

2. Remove the tab operating tube by pulling it aft and at the same time guiding the universal joint through the bearing in the rudder's leading edge.

   NOTE: If the rudder is assembled to the airplane, disconnect the operating tube as directed in paragraph C, 2, of this section.

E. TO REMOVE ELEVATORS (Remove one at a time - not as a set.)

1. Disconnect the elevator tab operating tube in the same manner as for the rudder.

2. Disconnect the elevator controls at the elevator horns.

3. Disconnect the elevator torque tube from the horn casting.

4. Remove the bolts holding the elevator hinge brackets to the horizontal stabilizer.

F. TO REMOVE ELEVATOR TABS & OPERATING TUBES

1. Remove the two hinge bolts in each tab and pull the tabs straight out.

2. To remove the tab operating tubes, see directions for removing the rudder tab, paragraph D, this section.

G. TO REMOVE VERTICAL STABILIZER

1. Support the fuselage on the jack pad or by means of the hoisting tube. See Section III, B.

2. Remove the rudder.

3. Remove the vertical and horizontal stabilizer fairing.

4. Remove the tail shock strut bolt at the upper fitting. See Section VII, D, C, and E for removal of the complete tail wheel assembly.

5. Remove the elevators.

6. Remove the tail casting, and spacers.

7. Remove the bolts through the vertical stabilizer closing channel.

8. Disconnect the tail light wiring at the junction box on the forward side of Frame #14 1/2 and loosen the conduit jam nut on the aft side of the same frame.

9. Remove the bolts that attach the forward part of the vertical stabilizer to the fuselage.

10. Pull the stabilizer straight aft being careful not to bend the rudder tab operating tube.

11. The rudder tab operating tube that extends through the vertical stabilizer may be removed by removing the cable drum on the forward end of the tube. This is not essential, but it is recommended to prevent injury to operating tube.

H. TO REMOVE THE HORIZONTAL STABILIZER

1. Support the fuselage on the jack pad or by means of the hoisting tube.

2. Remove the rudder.

3. Remove the elevators.

4. Remove the vertical stabilizer.

5. Remove the rudder tab operating tube.

6. Remove the elevator tab operating tubes by disconnecting them from the drums on their forward ends.

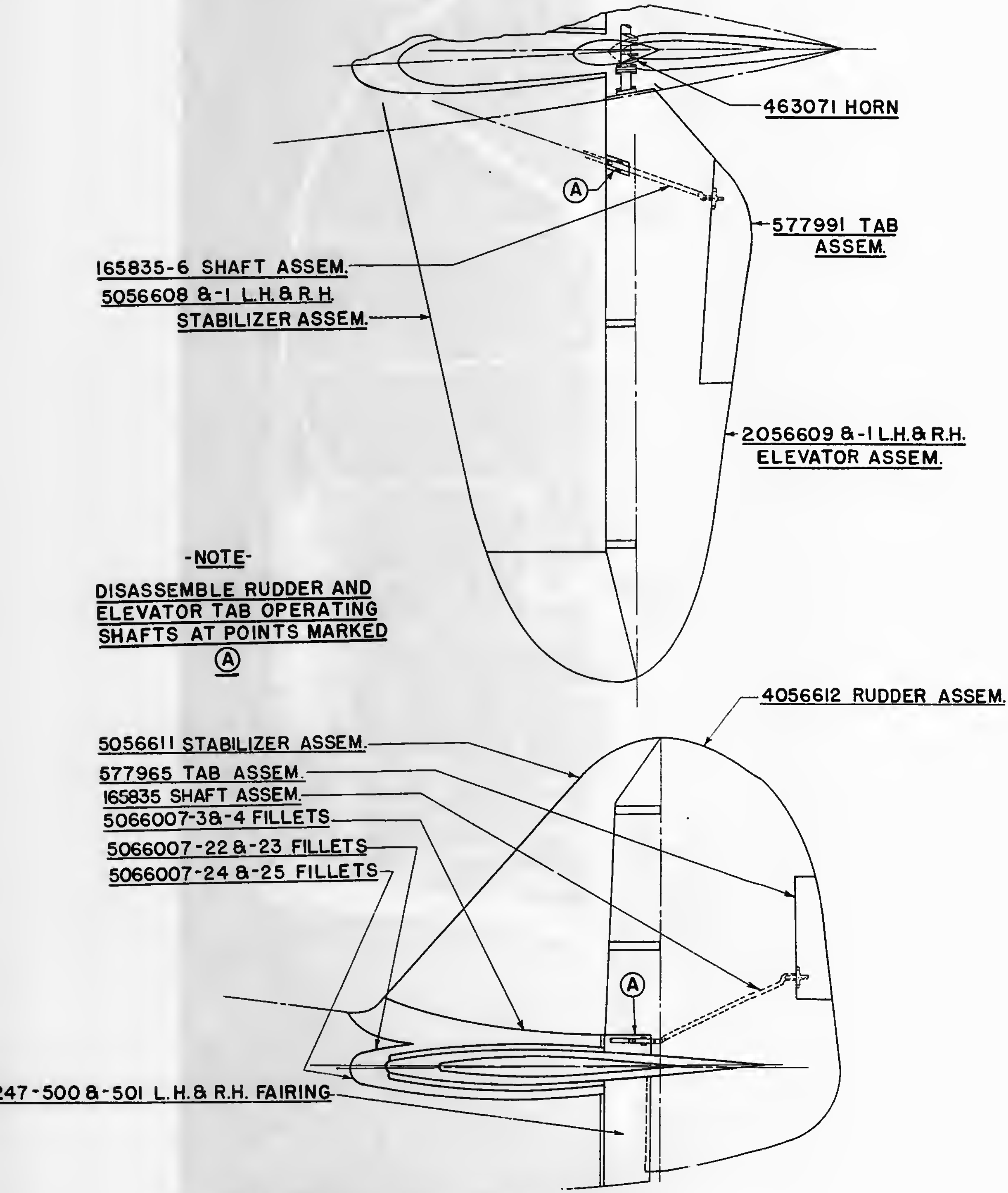
7. Remove the bolts attaching the horizontal stabilizer attaching flange to the skin and the bolts through frames #14 1/2 and #15.

8. Lift the stabilizer off.

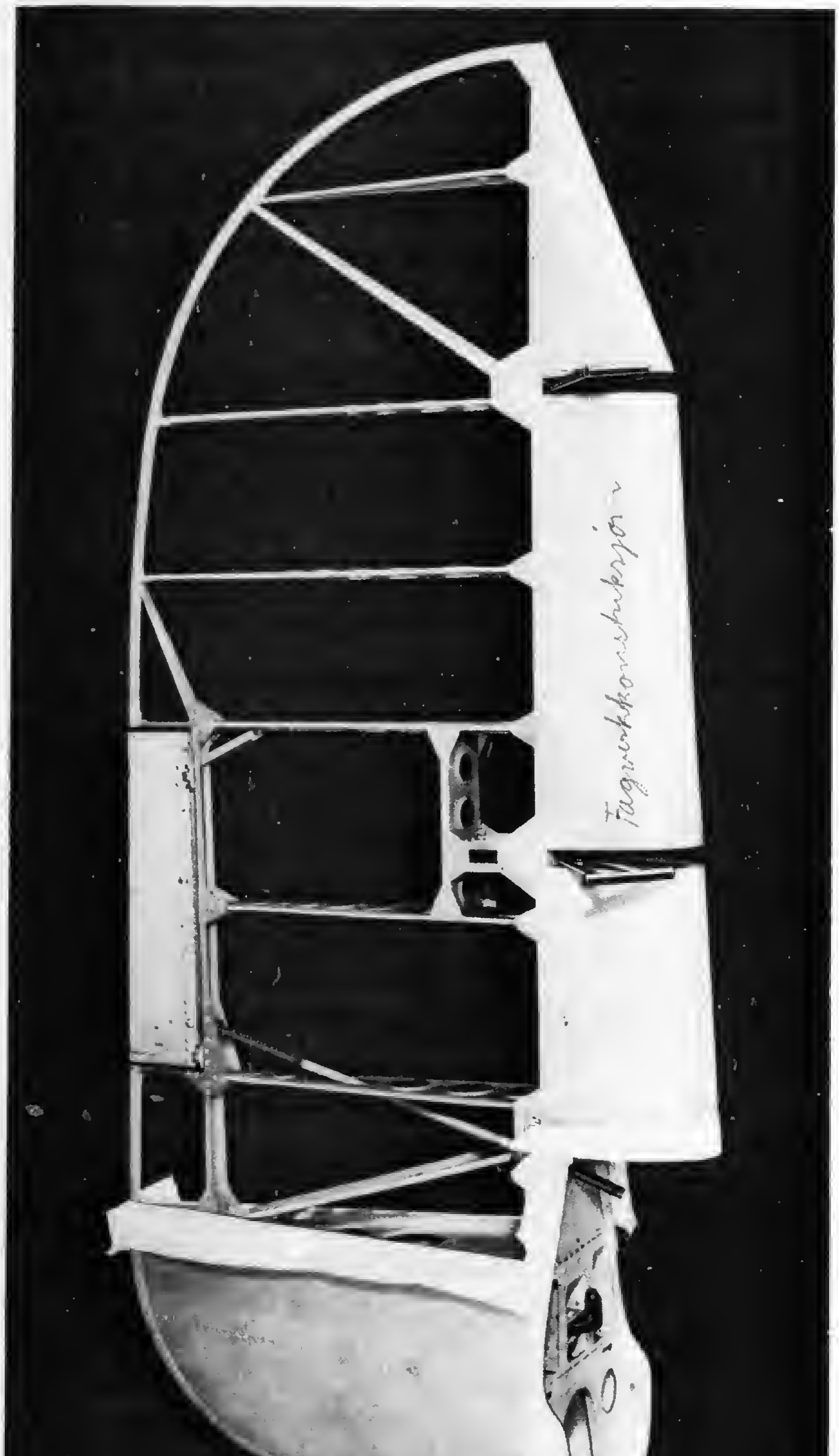
I. MAINTENANCE

1. Keep all parts well lubricated. See Lubrication Chart page XXIII - 28.

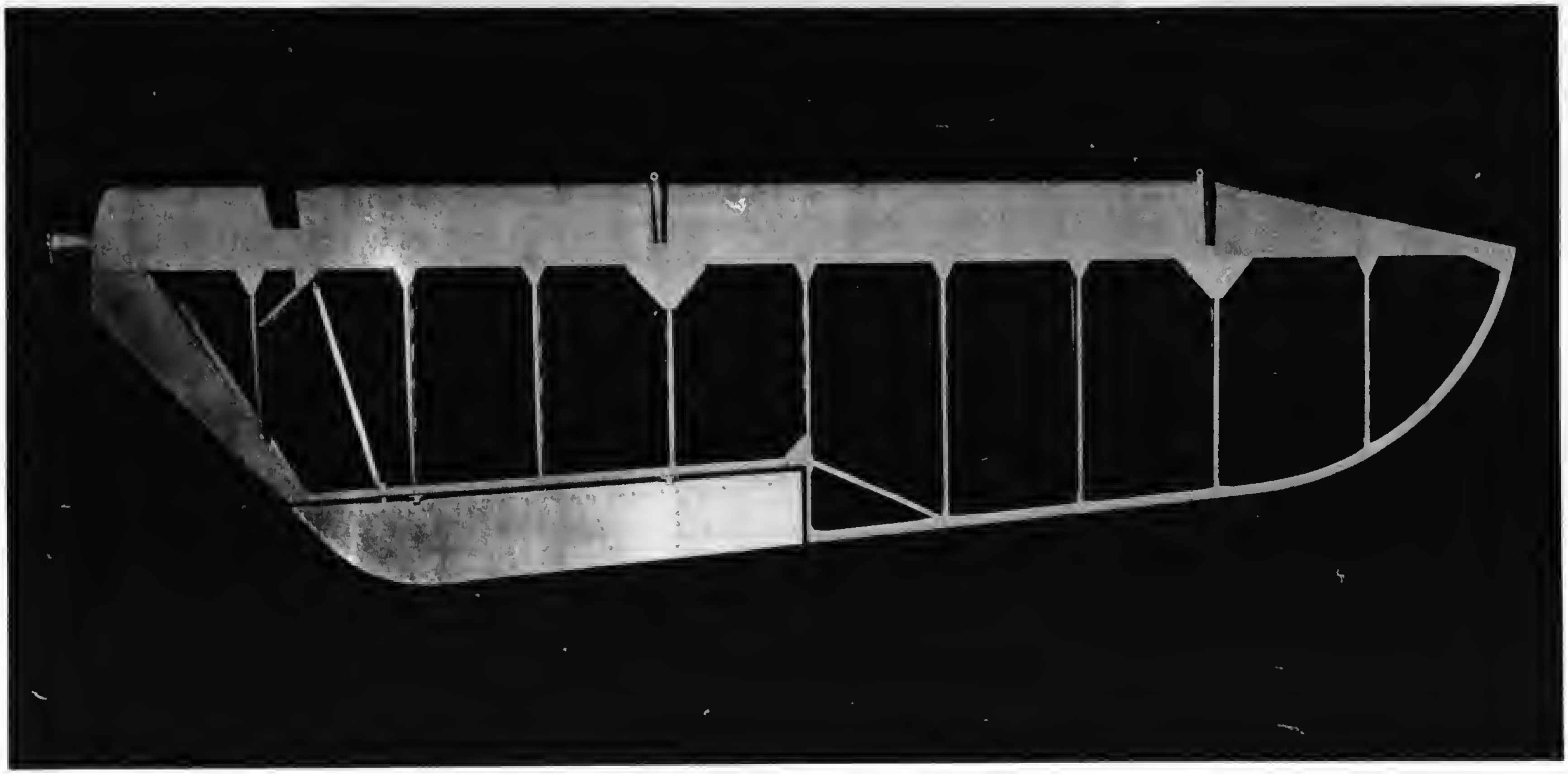
2. See Section XXIII for additional maintenance instructions.



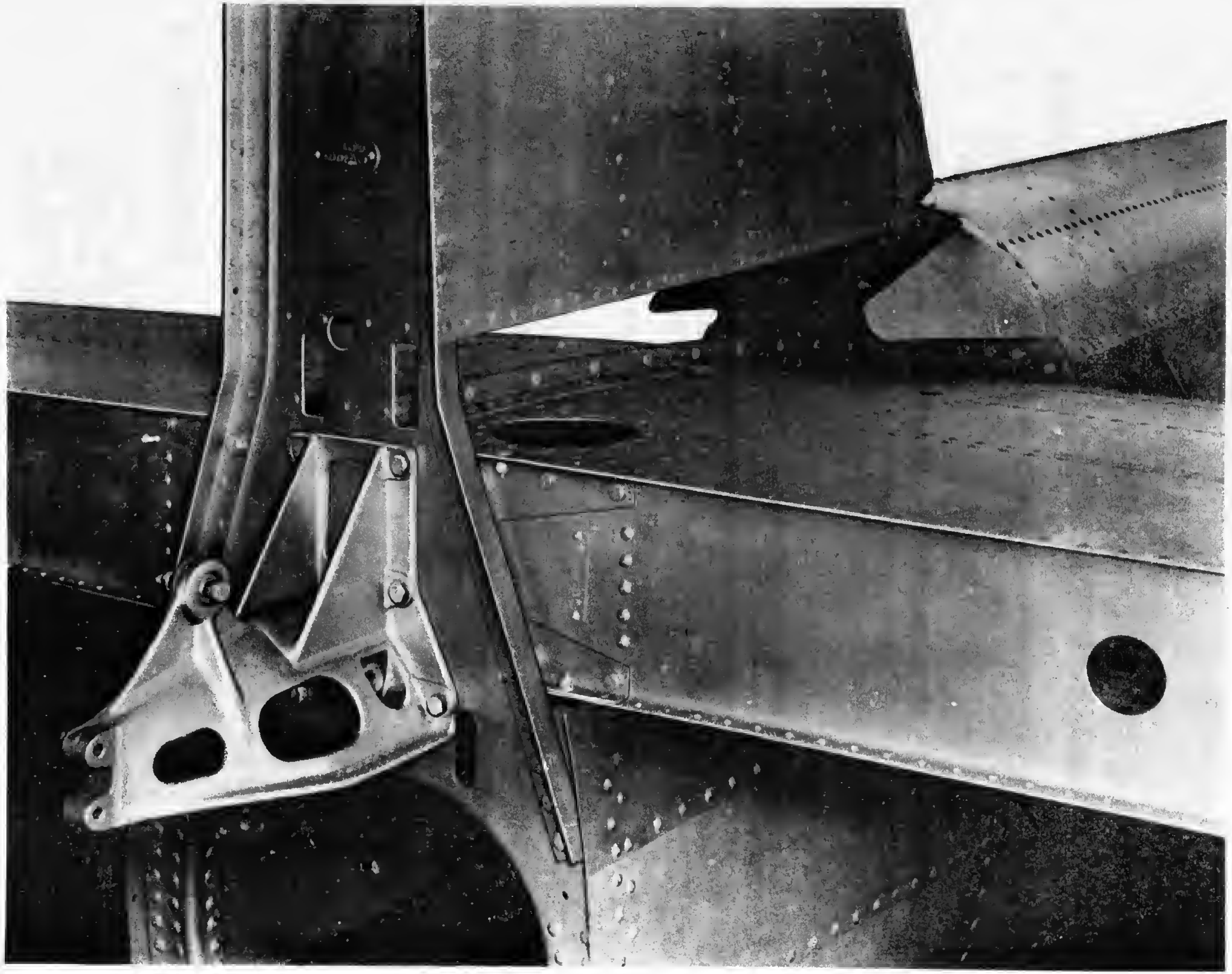
EMPENNAGE INSTALLATION



2080 - Rudder Frame Assembly



1852 - Elevator Frame Assembly



2013 Stabilizer Installation

SECTION VI

FUSELAGE

A. DESCRIPTION

1. The fuselage is of the stressed skin semi-monocoque type of construction, consisting essentially of channel type frames, spaced at approximately 18 inch (45 cm.) intervals, covered with a smooth alclad skin. The skin is stiffened longitudinally by extruded aluminum alloy bulb angles spaced at approximately 5 inches (13 cm.), and extending the entire length of the fuselage. Special stiffeners are used to distribute concentrated stresses at the engine mount fittings, cockpit cutouts, tail wheel fittings, bomber's compartment cutout, etc.

2. A superstructure which is designed to protect the pilot and gunner in case of a complete turnover, extends to the top of the cockpit enclosure.

3. The center section of the wing is built integral with the fuselage.

4. Two steel retracting steps are provided on the left side of the fuselage to assist in entering the rear cockpit.

5. A retractable bomber's compartment, hinged at its forward end is located under the rear cockpit. The compartment is lowered and raised by operating the hand crank located on the left side of the rear cockpit. This crank is convenient to the right hand of the occupant of the rear seat when facing aft.

6. Provision is made in the rear section of the fuselage, just forward of the horizontal stabilizer, to insert a lifting bar 1 1/8 inches (2.8 cm.) in diameter.

B. INSTALLATION

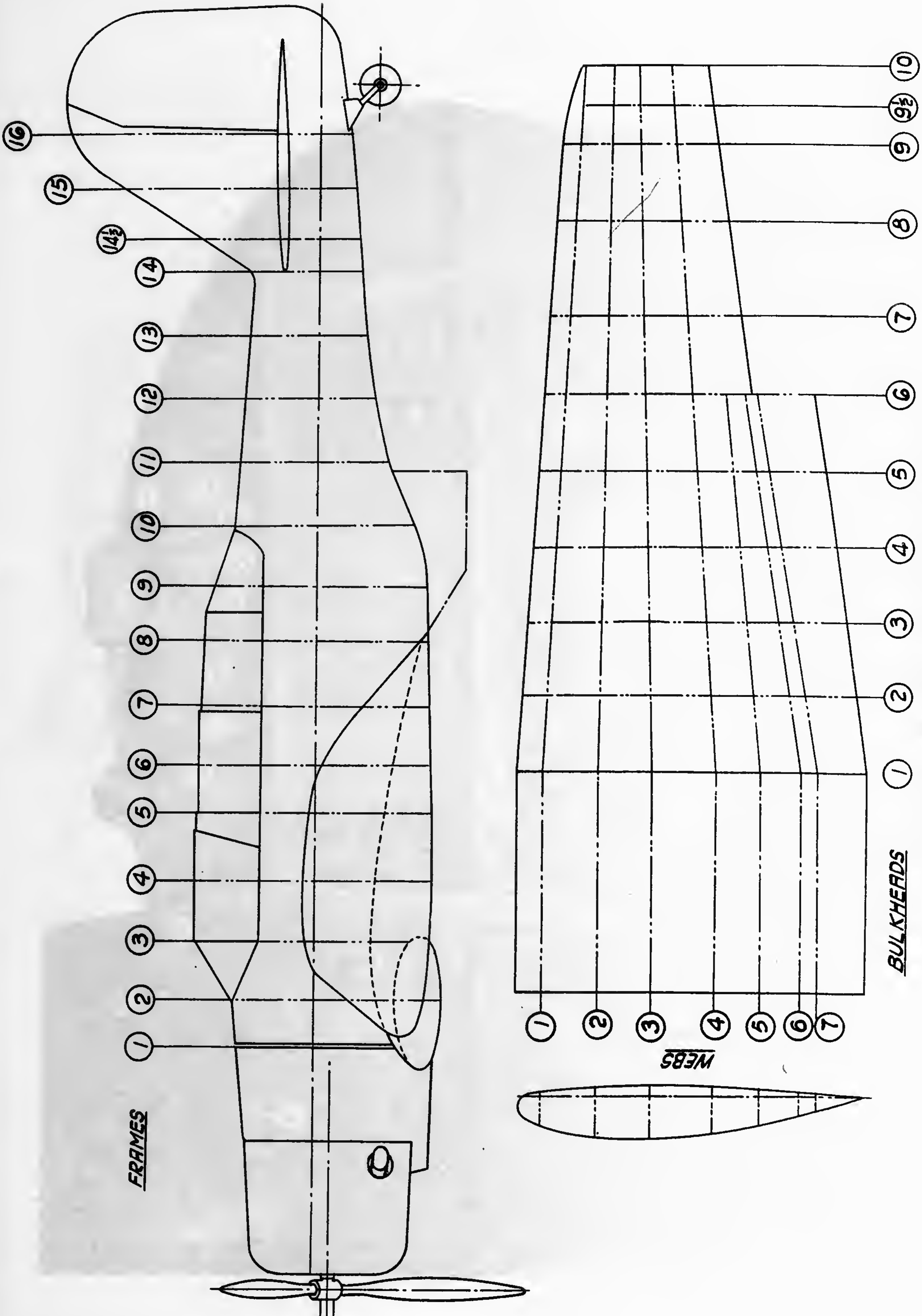
1. Support the fuselage at the forward end by means of a sling, attached to the hoisting lugs screwed into the threaded holes in the top of the wing center section. The fuselage should be raised high enough to permit extension of the landing gear.

2. Support the tail in approximately the level position by a sling attached to the hoisting bar or by a support placed under the jack pad. See Section III, B, C, D, and E for detailed instructions.

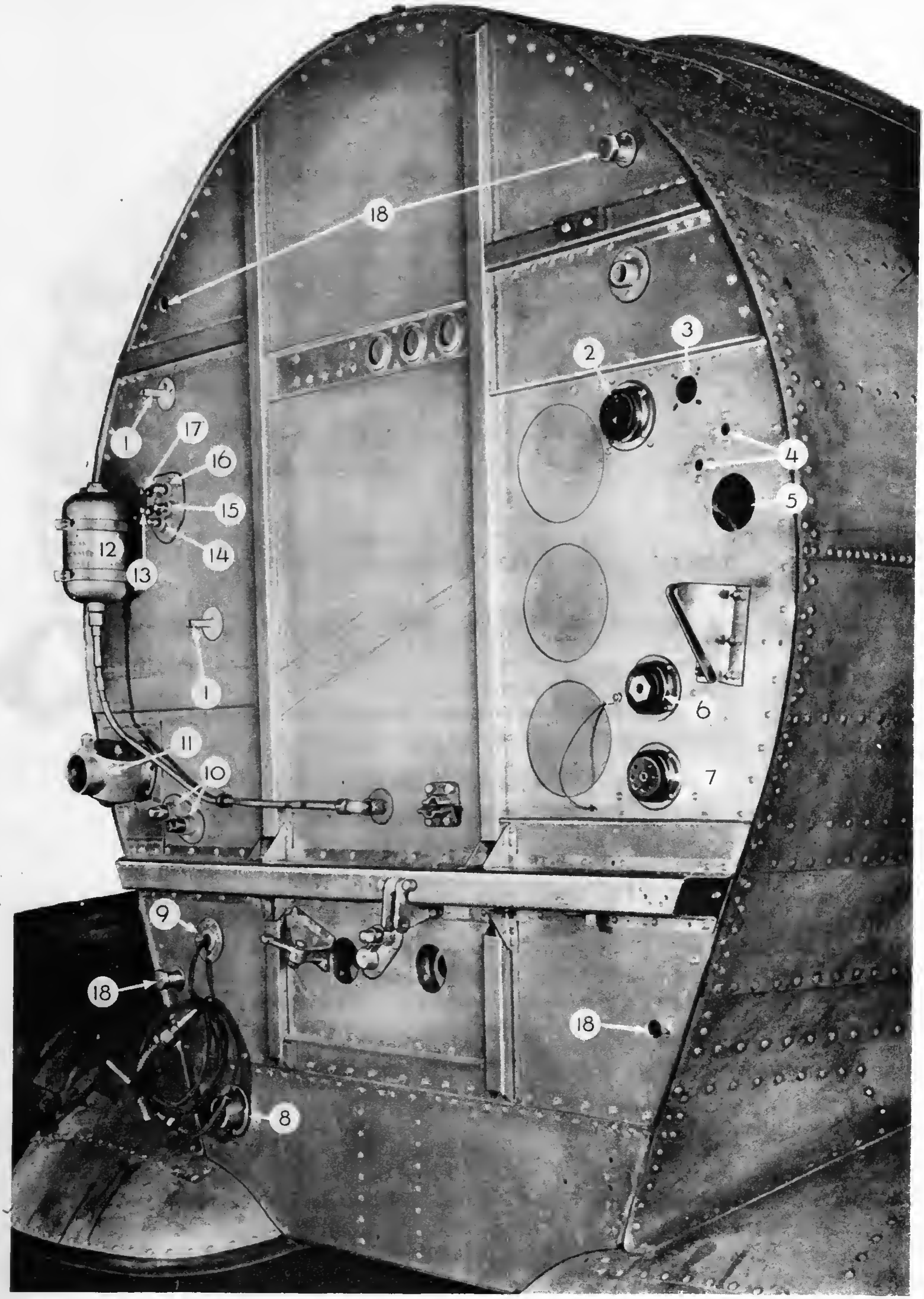
NOTE: The fuselage is the base structure upon which all other structures assemble, therefore the preceding information concerns only handling, leveling, etc., of the fuselage for the installation of these structures.

C. MAINTENANCE

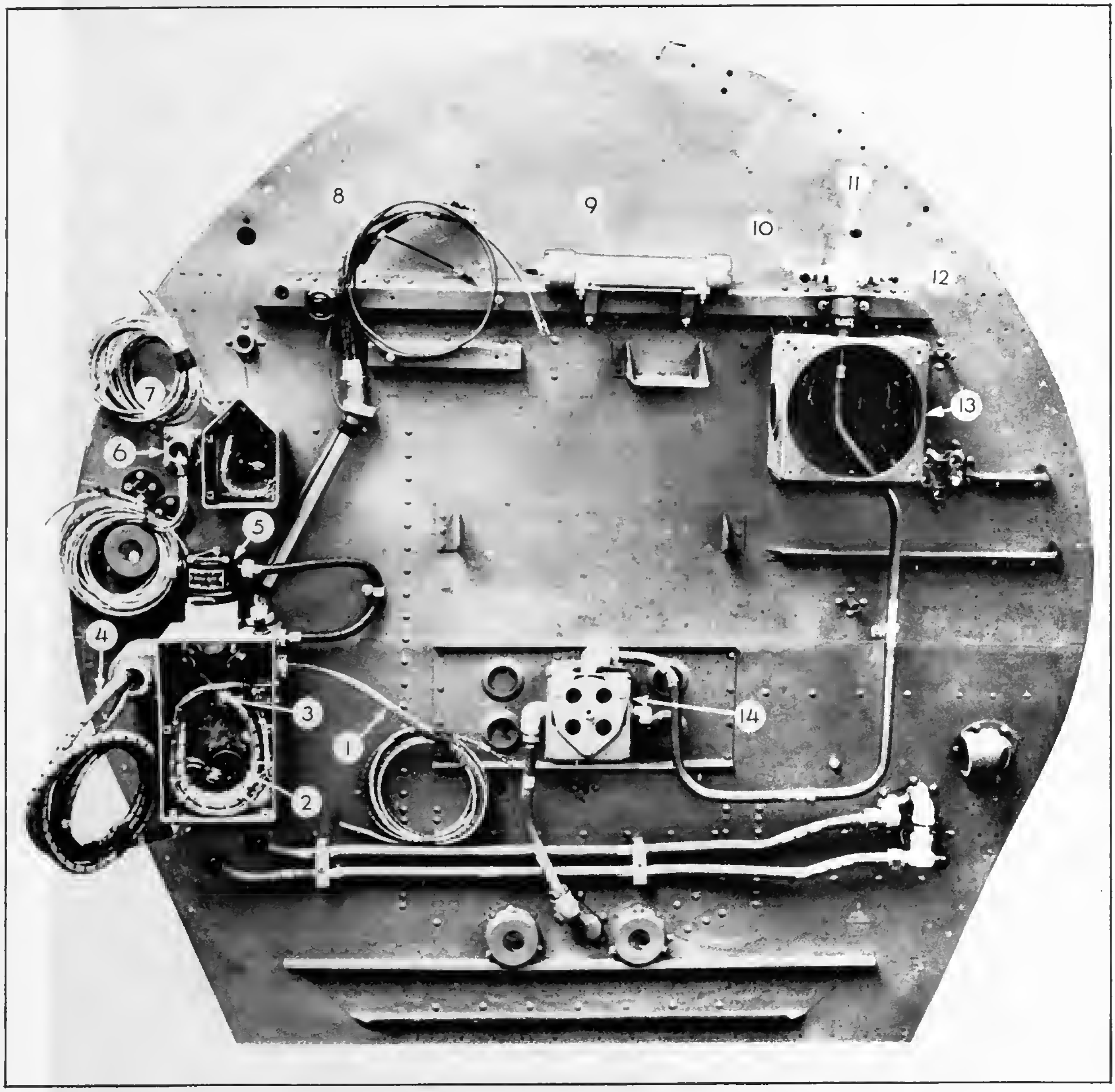
1. Detail maintenance requirements are covered in Section XXIII.



FUSELAGE & WING STRUCTURE DIAGRAM
MODEL 8A-5

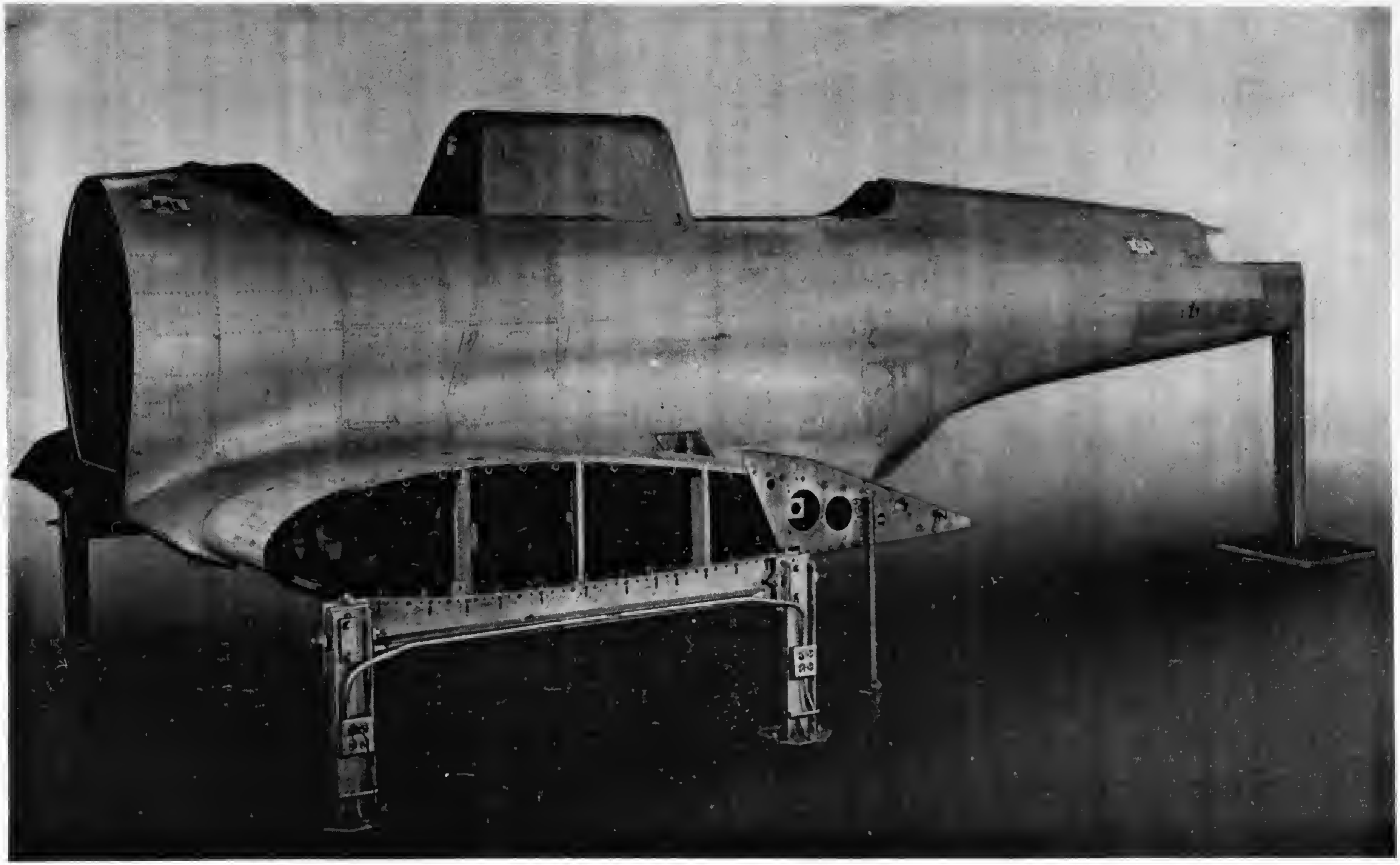


8221 - Firewall Installation - Front View



1. Wires to Foot Pedal Switch Box
2. Electrical Receptacle
3. Starter Receptacle
4. Conduit to Switch Box
5. Starter Solenoid Switch
6. Propeller Wiring
7. Ignition Wiring
8. Generator Control Box Wiring
9. Hydraulic Surge Cylinder
10. Bank & Turn Indicator
11. Artificial Horizon Indicator
12. Learmatic Indicator
13. Cell-Aero Mixture Indicator
14. Vacuum Selector Valve

8080 - Firewall - Rear View



5150 - Fuselage Structure Assembly

SECTION VII

TAIL WHEEL

A. DESCRIPTION

1. The tail wheel is the steerable cantilever knuckle type. It is steerable with the rudder for 30° on each side of neutral. Beyond this limit however, the steering mechanism is automatically released and the wheel is free to swivel throughout the remaining 300°. An anti-shimmy device consisting of a spring loaded clutch plate is incorporated. A steel coil spring is attached in each steering cable to keep sudden severe loads from being transmitted through the rudder cables to the rudder pedals.

2. The tail wheel shock absorbing unit is the oleo pneumatic type and is attached to the hinged yoke on the lower end and to the fuselage tail frame on the upper end.

3. A 13.25 inch (33.6 cm.) streamline tire and wheel is mounted to the knuckle on tapered roller bearings. The bearings are fully enclosed.

B. INSTALLATION

1. Lift the tail of the fuselage.

2. The vertical and horizontal stabilizers must be in place before the wheel assembly can be installed. See Section V, B, 1 to 6 inclusive.

3. Place the tail wheel assembly in position and put in the two bearing bolts that attach the yoke to the fuselage frame.

4. Bolt the upper end of the shock strut to the tail casting.

   NOTE: At this point it is assumed that the tail wheel assembly is complete as a unit and needs only to be installed on the airplane. If the parts must be assembled see page VII - 5.

5. Attach the pulley swivels to the support brackets and attach the cable ends to the steering arm. See page VII - 6.

6. Attach the fairing with the machine screws furnished. (The fairing cannot be installed until the empennage has been completely assembled.)

C. TO REMOVE TAIL WHEEL

1. Remove the cover plate from right side of wheel.

splint underlagskive lager

2. Remove cotter, nut, washer and outer bearing.

3. Remove wheel.

D. TO REMOVE SHOCK STRUT

1. Remove tail wheel fairing and rudder fairing.

2. Remove the bolt through the yoke at the lower end of the oleo strut being careful that the remainder of the assembly, still attached to the airplane, is properly supported.

3. Remove the upper bearing bolt and the strut.

E. TO REMOVE THE TAIL WHEEL ASSEMBLY

1. Remove the tail wheel fairing and the rudder fairing.

2. Disconnect the steering cables at the steering arm and remove the pulleys from their swivels on the yoke.

3. Remove the bearing bolt at the lower end of the shock strut. Have the assembly well supported during this operation.

4. Remove the two bearing bolts that attach the yoke to the fuselage frame.

F. TO REPLACE SHOCK STRUT PACKING

1. See the Cleveland Pneumatic Tool Co. Instructions for Aerol Struts, also page VII - 4.

G. MAINTENANCE vedlikehold

1. Check the tire daily for proper inflation, 36 lbs. per sq. in. (2.5 kgs./cm^2) See Section XII, D, 4.

2. Check the wheel for looseness or binding in the bearings.

3. Check the shock strut daily for proper inflation and oil leakage. Instructions for proper inflation of the strut will be found on the plate attached to the strut or to the rudder fairing.

4. Check the oil level in the shock strut every 40 hours, or at such time as the strut shows leakage. The following procedure should be observed:

(a) With airplane in static position, remove air valve body. Do not depress valve core.

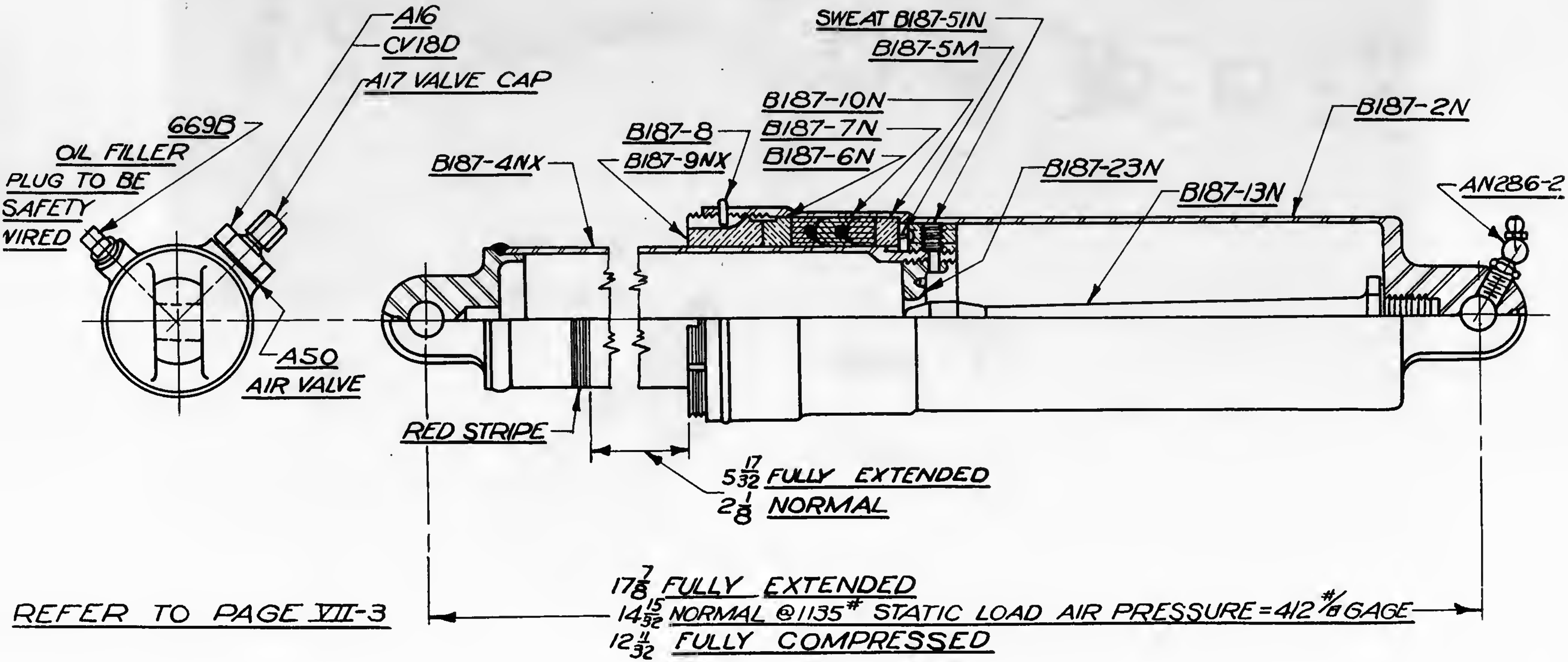
(b) After the strut is fully compressed, remove oil filler plug and fill with Lockheed No. 5 hydraulic fluid.

(c) Replace and safety oil filler plug.

(d) Replace air valve and inflate the strut to proper taxiing position.

(e) If there is an indication of leakage at the packing gland, deflate strut as in (a) above and tighten the packing retainer nut until slot in nut matches the hole in the side of the cylinder. Replace packing retainer lock wire and fill to oil level as in (b) and (c) above.

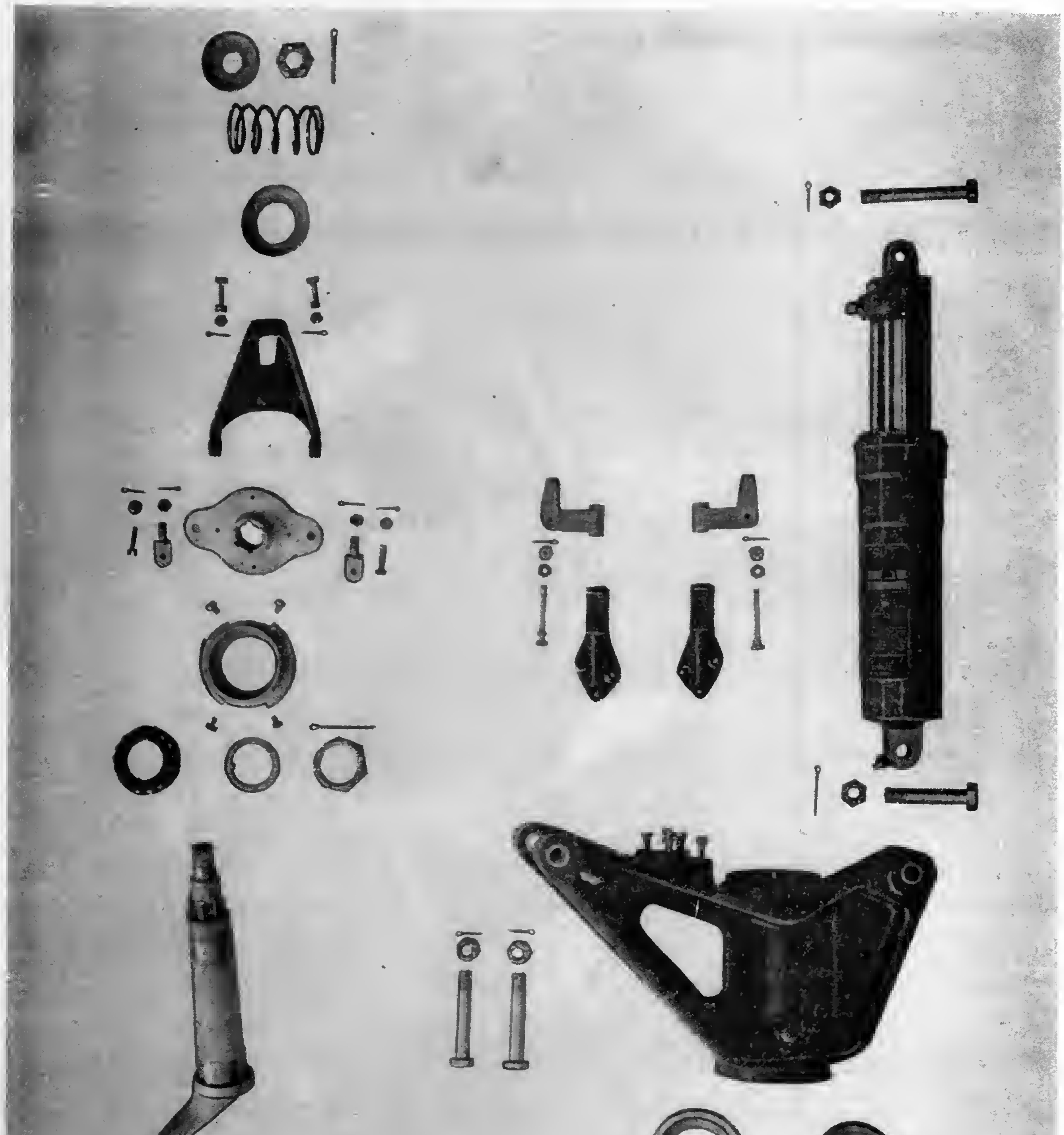
5. See Section XXIII, for additional maintenance information.



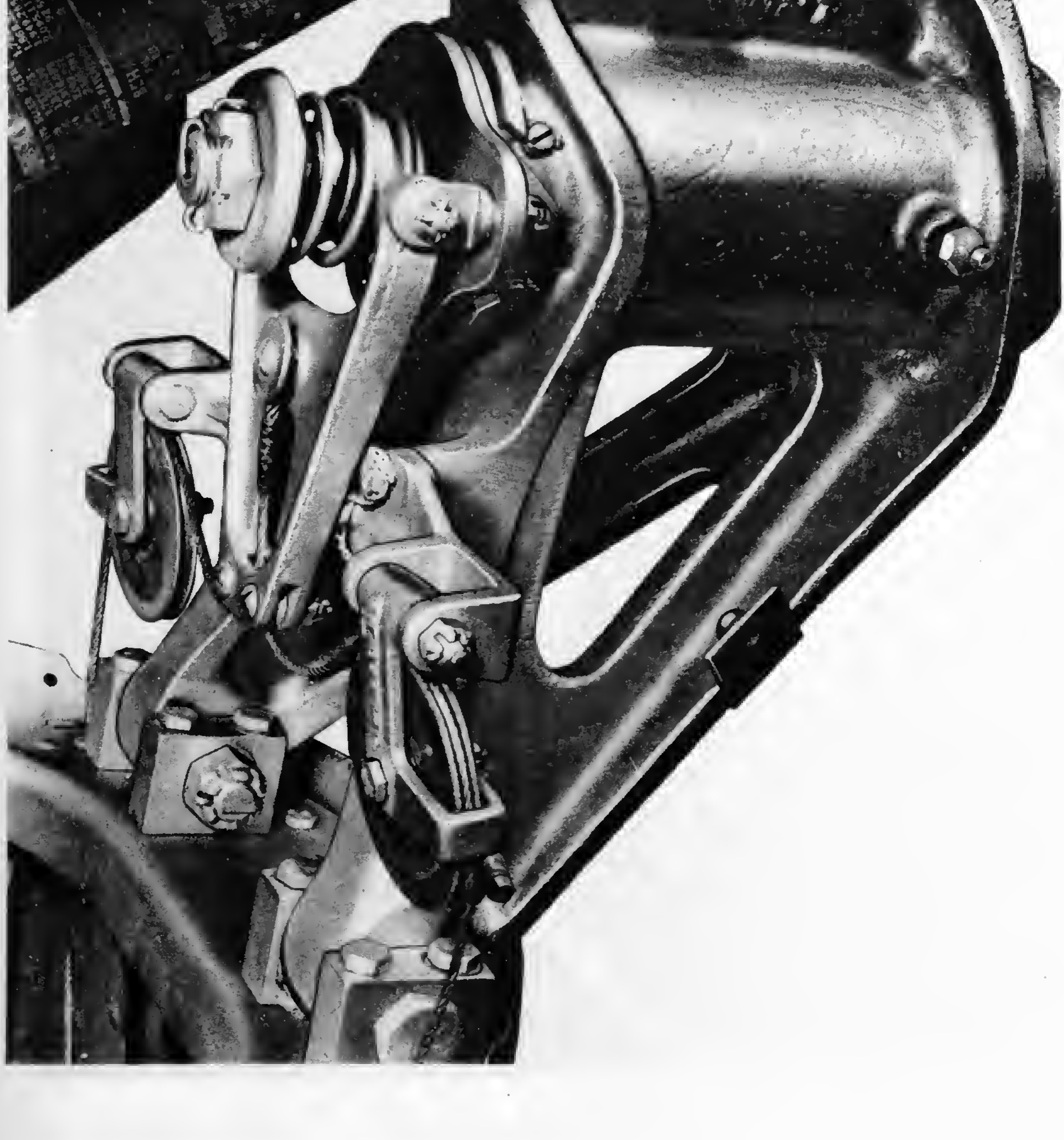
REFER TO PAGE VII-3

REFER TO CLEVELAND PNUEMATIC TOOL CO. DWG. XA-4769

TAIL WHEEL SHOCK STRUT



2077 Tail Wheel Breakdown



8120 Tail Wheel Steering Mechanism

1. Hinged Yoke 2. Shock Strut

5528 - Tail Wheel Installation

SECTION VIII

POWER PLANT

A. DESCRIPTION

1. This airplane is powered with a Wright "Cyclone" model, GR1820-G205A air cooled radial engine, geared 3:2. It is designed to operate on 90 Octane (W.A.C. Specification No. 5804) fuel. Recommended oil is that defined on the W.A.C. Specification No. 5817.

2. The engine is mounted in rubber absorbers on a welded tubular steel engine mount.

3. The engine is cranked by an Eclipse, Series 11A, hand or electric inertia starter. The electric starter is remotely controlled from a foot pedal operated switch on the forward right side of the pilot's floor The hand crank is inserted into the lower right side of the engine accessory cowling and meets a tubular extension arm which is attached to the inertia starter.

4. Other engine accessories include:

1	Carburetor, Bendix Stromberg,	Model PD12H3 SU362 W.A.C.
1	Generator, Eclipse, 30 volts 50 amps #314,	Model 21 Type E-7
1	Pump, Hydraulic, Pesco	Type 203 A.D.
1	Pump, Vacuum, Pesco	Model 194, Type B2-A
1	Pump, Fuel, Pesco	Model R600 C.W.
1	Pump, Check Valve Vacuum, Pesco, Model 226	
1	Valve, Suction Relief, Pesco, Model 195	

5. (a) A three blade Curtiss Electric Propeller, multi-position and/or constant speed, dural, 10 ft.6 in.(3.2 m) in diameter, #C-532D with #89306-10-6 blades is used. The propeller controls are located forward from frame #4, left side of the pilot's cockpit about 3 in (7.5 cm.) below the edge of the cockpit.

   (b) The propeller is operated electrically from the airplane supply through brushes mounted in a housing, attached on the engine nose section to slip rings mounted on the rear boss of the propeller hub, and thence to the pitch changing motor Automatic electric cutout switches limit the pitch range for ordinary operation, and give high and low pitch settings.

(c) Two types of control, manual selective and automatic, are available for selection by the pilot, the change from one to another being made by a toggle switch located on the propeller control panel.

Automatic: When on automatic control, a selected engine speed is held constant by an engine driven governor. Speed selection is accomplished by adjustment of the propeller governor control.

Manual selective: When on manual selective control, the propeller acts as a controllable pitch propeller, the blade angle of which may be varied by operation of the "Increase RPM" or "Decrease RPM" switch. Circuits are independent of the governor so that if the governor fails the propeller can be used as a multi-position controllable propeller.

(d) Since the markings on the propeller control are for approximate settings, the tachometer should be relied upon to obtain the desired r.p.m. For complete instructions for this propeller refer to "Installation and Maintenance Instructions" manual, issued by Curtiss Propeller Division, Curtiss-Wright Corporation.

6. The engine throttle, mixture and supercharger control levers are located on the left side of the pilot's cockpit. Tubular push-pull rods with ball bearing ends connect the control levers with the carburetor. The change in direction at the firewall is accomplished with ball bearing bell cranks.

7. The stainless steel exhaust collector is located behind the cylinders of the engine. The collector is divided into sections which are held together by stainless steel sleeves The stacks from the exhaust ports are rigidly bolted to the cylinders; thus supporting the collector, while the slip joints (sleeves) allow each section to expand or contract without undue strain on the attaching parts. The collector exhausts through each side of the engine ring cowling below the fuselage centerline.

8. The fuel gage is operated electrically and is mounted on the engine instrument panel in the pilot's cockpit.

9. A carburetor air intake control, locking lever type, is located on the control pedestal, pilot's cockpit, between the rudder pedals. This control operates a valve which

closes the air intake scoop, thus permitting carburetor air to enter the carburetor inside the engine cowling, and aft of the cylinders.

B INSTALLATION

1. Engine

(a) Remove carburetor, fuel and vacuum pumps

(b) Hoist engine into a vertical position

(c) Assemble in succession on the engine, the two pan units of the diaphragm Assemble the three skirt units of the diaphragm, bolting the units securely to each other

(d) Bolt the assembled diaphragm skirt units in position on the engine mount.

(e) Insert the rubber absorbers through the engine mount lugs on the engine mount. The front absorbers hold the diaphragm in place

IMPORTANT: See page VIII - 11 (Engine Mount Absorber Installation)

(f) Insert the dural spacers through the absorbers

(g) Bolt the engine to the mount using the nine bolts and eighteen washers furnished The front washers fit between the engine lugs and the rubber absorbers

(h) Assemble the carburetor, fuel and vacuum pumps, electrical ground cable and starter crank extension.

(i) Connect all wires, controls, fuel and oil lines, instrument lines, tachometer shaft, and magneto cooler tubes.

(j) Assemble the exhaust collector, bolting the stacks securely to the cylinder exhaust ports.

(k) Attach the hot air duct between the valve on the firewall and the hot air collector around the upper section of the exhaust manifold

(l) Install cowling. See page IX - 1

2. Propeller (Blade 89306, Assembly C-532D.)

(a) See "Installation and Maintenance Instructions" manual issued by the Curtiss Propeller Division, Curtiss-Wright Corporation, for installation procedure and maintenance instructions.

C TO REMOVE ENGINE

1. Remove all cowling. See page IX - 3.

2. Support engine.

3. Remove propeller.

4. Drain oil.

5. Remove the carburetor, fuel and vacuum pumps and exhaust collectors.

6. Disconnect the following;

(a) All wiring at the firewall and junction boxes (attached to left engine mount tubes).

(b) All fuel, oil and instrument lines, and magneto cooler tubes.

(c) Tachometer shaft.

(d) Starter crank extension.

(e) Heater tubes.

7 Disconnect the nine attaching bolts and remove the engine.

D. MAINTENANCE

1. Refer to the "Instruction Book for Wright Cyclone Engines" for complete instruction on this engine. Refer to "Installation and Maintenance Instructions" manual, issued by Curtiss Propeller Division, Curtiss-Wright Corporation, for maintenance instructions on this propeller. Also see Section XXIII for periodic maintenance and inspection instructions.

E. OPERATING CHARACTERISTICS

1. Operating characteristics of the engine will be found in the tables following on the next page:

Indizierte Pk = I. HP
Bremspferdekräfte B. HP

Horsepower Rating	BHP	RPM	Pressure Altitude Meters	Manifold Pressure cm. Hg.
Take-off (low blower)	1200	2500	Sea Level	115.5
Military (low blower)	1200	2500	S.L. 1295	115.5-109.2
Military (high blower)	1030	2500	2820-4267	113.0
Normal (low blower)	1000	2300	S.L. 2130	99.3- 94.7
Normal (high blower)	900	2300	2957-4633	106.2- 92.4
Maximum Cruising (either blower)	650	2000	S.L. 5800	
Recommended Cruising (either blower)	575	1900	S.L. 6175	

<u>Maximum Diving Speed</u> - Never exceed 2670 r.p.m.

<u>Fuel</u> W.A.C. Specification 5804 - 90 Octane
Required pressure at carburetor inlet .984 - 1.124 kgs/cm^2.

<u>Oil</u> W.A.C. Specification 5817
Required pressure - 4.56 - 5.27 kgs/cm^2.
Desired oil inlet temperature............74°C.
Maximum oil inlet temperature............88°C.
For emergency only ....104°C.

<u>Cylinder Head and Base Temperature Limitations</u>

	Head	Base
Ground operation................................	232°C.	163°C.
Military power climb and level flight.....	232°C.	163°C.
Normal rated power climb and level flight.	218°C.	149°C.
Cruising power climb........................	218°C.	149°C.
Cruising power level flight	205°C.	149°C.
Minimum for take-off	150°C.	

F. <u>OPERATION</u>

1. <u>Pre-starting procedure</u>

(a) Make sure that the parking brakes are locked on, or that the wheels are blocked; that the landing gear selector valve lever is in the down position; that the spreader bar is removed from between the wheels and that the master battery switch is on.

(b) Check the quantity of fuel in each tank and set the selector valve to the tank to be used.

(c) Check the quantity of oil in tank and see that all oil lines are open.

(d) If the engine has not been running within the past hour, pull the propeller through by hand, at least four revolutions in direction of rotation, to insure that the combustion chambers are clear of any liquid.

(e) Set throttle slightly open for 600 - 800 r.p.m

(f) Set fuel mixture control lever to the "FUEL CUT-OFF" position.

(g) Set supercharger lever in "LOW" blower position.

(h) Set propeller safety switch to "ON" and selector switch to "AUTOMATIC". Governor control set at 2500 r.p.m. position.

(i) Carburetor air control in "OFF" position, until engine has started. This is a precaution against fire in case of possible engine back-firing.

2. <u>Starting</u>

(a) Operate the fuel hand pump <u>slowly</u> until .703 to 1.124 kgs/cm^2 fuel pressure is attained A greater pressure may flood the carburetor and make starting difficult. Keep the handle forward when pump is not in use, to clear the bomb release unit.

(b) Prime 5 or 6 strokes. If engine is warm no prime is necessary. <u>KEEP THE PRIMER VALVE OFF EXCEPT DURING PRIMING OF THE ENGINE</u>. The pressure pump is located on the right side of the pilot's cockpit below the engine instrument panel. Priming should be done while the inertia starter is being wound up, thus the raw fuel will remain in the cylinders the shortest possible time. If additional priming should be necessary to keep the engine running, prime with the pressure pump -- <u>Do not move the throttle</u>.

(c) Make sure there is no obstruction in the arc of the propeller.

(d) Use of inertia starter at this point.

<u>Hand</u> -- Insert inertia starter crank in the crank extension right side accessory cowling, wind up to speed necessary to turn engine (for a period of thirty seconds or when winding has reached the pitch deemed necessary to pull the engine through).

Turn ignition switch to "BOTH", (located at bottom of electrical switch panel, left side of front cockpit).

Depress with heel the rear end of the starter pedal (right forward corner of pilot's floor) which energizes the meshing solenoid and booster coil, thereby turning over the engine.

Electric -- Turn ignition switch to "BOTH". Depress with toe the forward end of the starter pedal (right forward corner of pilot's floor), which starts the electric motor of the inertia starter. Hold forward end of pedal depressed until the winding has reached the pitch deemed necessary to pull the engine through.

Depress with heel the rear end of the starter pedal, which energizes the meshing solenoid and booster coil, thereby turning over the engine.

NOTE: The electric inertia starter pedal is wired to the ignition switch, hence the necessity of turning the ignition switch on before starting the inertia motor. The starter pedal being inoperative when the ignition is off prevents accidental starting of the engine.

(e) If the engine does not start after two or three turns of the propeller, prime by moving the mixture control out of "FUEL CUT-OFF" for approximately 1/2 turn of the propeller and then back to "FUEL CUT-OFF". When the engine starts firing during this operation, move the mixture control to the "AUTOMATIC RICH" position.

(f) Continue to pump primer intermittently as required after the engine starts firing to keep it running. Do not move throttle. The primer must be "OFF" except when priming the engine.

CAUTION: Excessive priming has a tendency to wash the oil off the cylinder walls and cause scoring and seizing of the barrels and pistons. It also wets the spark plugs preventing their efficient functioning. Do not prime through the exhaust ports or spark plug holes with raw fuel.

(g) When the engine fires smoothly, open throttle slowly to 1000 r.p.m. Check oil pressure. If oil pressure does not reach 2 to 3 kgs/cm^2 within 30 seconds, stop the engine and investigate.

(h) If the engine does not start after several attempts, return the mixture control to the "FUEL CUT-OFF" position, turn off the ignition switch, and investigate the cause of the trouble.

3. Warm-up

(a) A thorough warm-up is recommended. During the warm-up, leave the carburetor air heat control in the same position as for starting. With the mixture control in the "AUTOMATIC

RICH" position, run the engine at 1,000 r.p.m. until the oil pressure indicates 2.8 to 4.9 kgs/cm^2. Then continue warm-up at 1,100 r.p.m. until the oil temperature reaches 38°C, or in cold weather, until the oil temperature rise of 6°C., minimum is obtained. This is an indication that oil is circulating properly through the engine and oil lines. If oil dilution is used for starting, the minimum oil temperature rise should be 21°C.

(b) Open the throttle to the recommended cruising manifold pressure long enough to check magnetos and the fuel and oil pressure. If the oil pressure drops or fluctuates when the throttle is opened, continue the warm-up. All checks and ground running should be performed with propellers in "AUTOMATIC" and governor control set at 2500 r.p.m.

(c) Do not exceed 76.2 cm. Hg. manifold pressure while making the magneto check. Check each magneto for r.p.m. drop and smooth running. Operate on a single magneto for as short a time as possible, and return switch to "both" after each check to permit the engine to clear out.

(d) Check the two-speed blower for proper functioning in the following manner: With the propeller in the high r.p.m. position, close the throttle completely, move the clutch control lever to the "high" position and lock. Open the throttle to obtain not over 76.2 cm. Hg. When the engine speed has stabilized, observe the manifold pressure and shift the blower control to the "low" position without moving throttle. A sudden decrease in manifold pressure is an indication that the two-speed supercharger drive is operating properly.

(e) Prolonged high power running should not be conducted on the ground since the cylinder cooling is insufficient. Do not exceed cylinder head temperature of 232°C.

4. Stopping Engine

(a) Idle the engine at 600 to 800 r.p.m. until cylinder head temperatures drop below 148°C.

(b) Decrease engine r.p.m. to 1000, hold for 30 seconds to obtain optimum scavenging of oil from the engine before stopping. Move mixture control lever to the "FULL LEAN" position. This actuates the idling cut-off valve which causes the engine to stop. Since the carburetor is not drained, leave the mixture control lever in the "FULL LEAN" position as a precaution against accidental starting. In stopping the engine, the throttle should not be open as this would force a charge of raw fuel into the cylinders.

(c) Turn the ignition switch to "OFF" after the propeller stops turning.

(d) Do not move the propeller until the engine is thoroughly cool.

5. Use of Carburetor Air Intake Control

(a) This engine is equipped with a Stromberg PD12H3 "non-icing" carburetor. Ice will not form in this carburetor due to vaporization of the fuel. Atmospheric ice (such as forms on the wing surfaces of the airplane) may form on the vents, booster venturis, throttles and the carburetor screen.

(b) Whenever atmospheric icing conditions are prevalent and the outside air temperature is below 6°C. it is recommended that the air intake control handle be set in the "ON" position for all conditions of flight. Never use partial heat. This practice is not recommended since with the scoop valve in intermediate positions severe turbulance is introduced in the carburetor air stream and this upsets the proper metering of the carburetor. When air intake control handle is in the heat "ON" position, always have the mixture control in the "AUTOMATIC RICH" position.

6. Use of Mixture Control

(a) The mixture control on the Stromberg PD12H3 carburetor has four definite positions: Full rich, automatic rich, automatic lean, and fuel cut-off.

(b) The fuel mixture control lever, marked "B" is one of the three levers on the engine control quadrant, left side of the pilot's cockpit.

(c) The "FULL RICH" position is when the lever is full forward. The "AUTOMATIC RICH" position is approximately 10° aft of the "FULL RICH" position and is felt by a distinctive "click", which is carried through from the control rod forward of the firewall. The "AUTOMATIC LEAN" position is approximately 10° aft of the "AUTOMATIC RICH" position, and is felt by a distinctive "click", which is carried through from the control rod forward of the firewall. The "FUEL CUT-OFF" position is full aft. The "FUEL CUT-OFF" position is painted red.

(d) The "FULL RICH" position is only used in emergencies. In the event the automatic mixture compensating device in the carburetor fails, which would be evidenced by lack of load or altitude compensation, the mixture control should be advanced to "FULL RICH". This makes the functioning of the carburetor similar to that obtained on a non-automatic carburetor.

(e) Fuel will flow with the mixture control in any position except "FUEL CUT-OFF" whenever the fuel pressure is above .350 kgs/cm^2 even if the engine is not running. Therefore, the mixture control should be left in "FUEL CUT-OFF" whenever the engine is not turning over, to prevent fuel from collecting in the diffuser section and running out the drain tube.

(f) Use of the mixture control in flight is given in the Pilot's Handbook, furnished with the airplane.

7. <u>Two Speed Supercharger Control</u>

(a) The supercharger control lever is marked "S" and is the center one of the three levers on the engine control quadrant, left side of cockpit. Care should be exercised at all times to <u>make sure that the supercharger clutch control is at the extreme end of its travel, either "HIGH or "LOW"</u>.

(b) The operation of the supercharger in flight, is covered in the Pilot's Handbook.

(c) <u>Be sure the control is in the "LOW" blower when running the engine on the ground</u>.

8. <u>Propeller</u>

(a) General: Set safety switch which is of the circuit breaker type to "ON" position at all times propeller control is desired. If the switch throws out, it may be reset by turning it to "OFF", then to "ON". Successive throwing out will probably be an indication of a short circuit or overload and the switch should be left off. In this event, the pitch should be changed only if absolutely necessary.

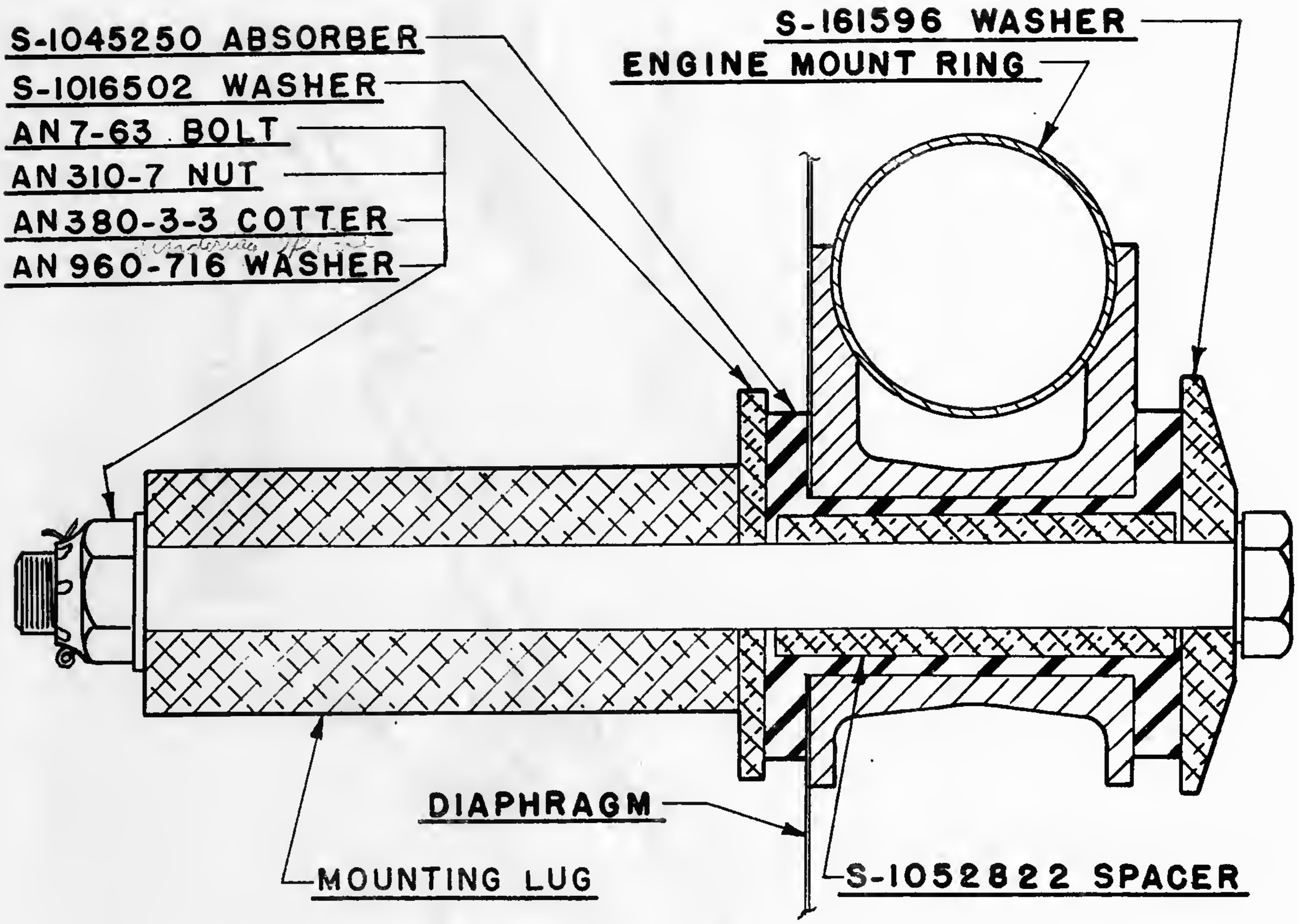
(b) Settings of mechanical and governor stops for various conditions are:

(1) The high r.p.m. propeller stop should be set so that the engine will turn 2550 r.p.m. with 115.5 cm. Hg. when the airplane is stationary.

(2) The take-off governor stop should be adjusted to permit 2500 r.p.m. with 115.5 cm. Hg.

(3) The propeller stop should be adjusted to give 2500 r.p.m. at 4267 meters at 113.0 cm. Hg. full throttle setting.

(c) Operating instructions for various flight conditions are given in the Pilot's Handbook.

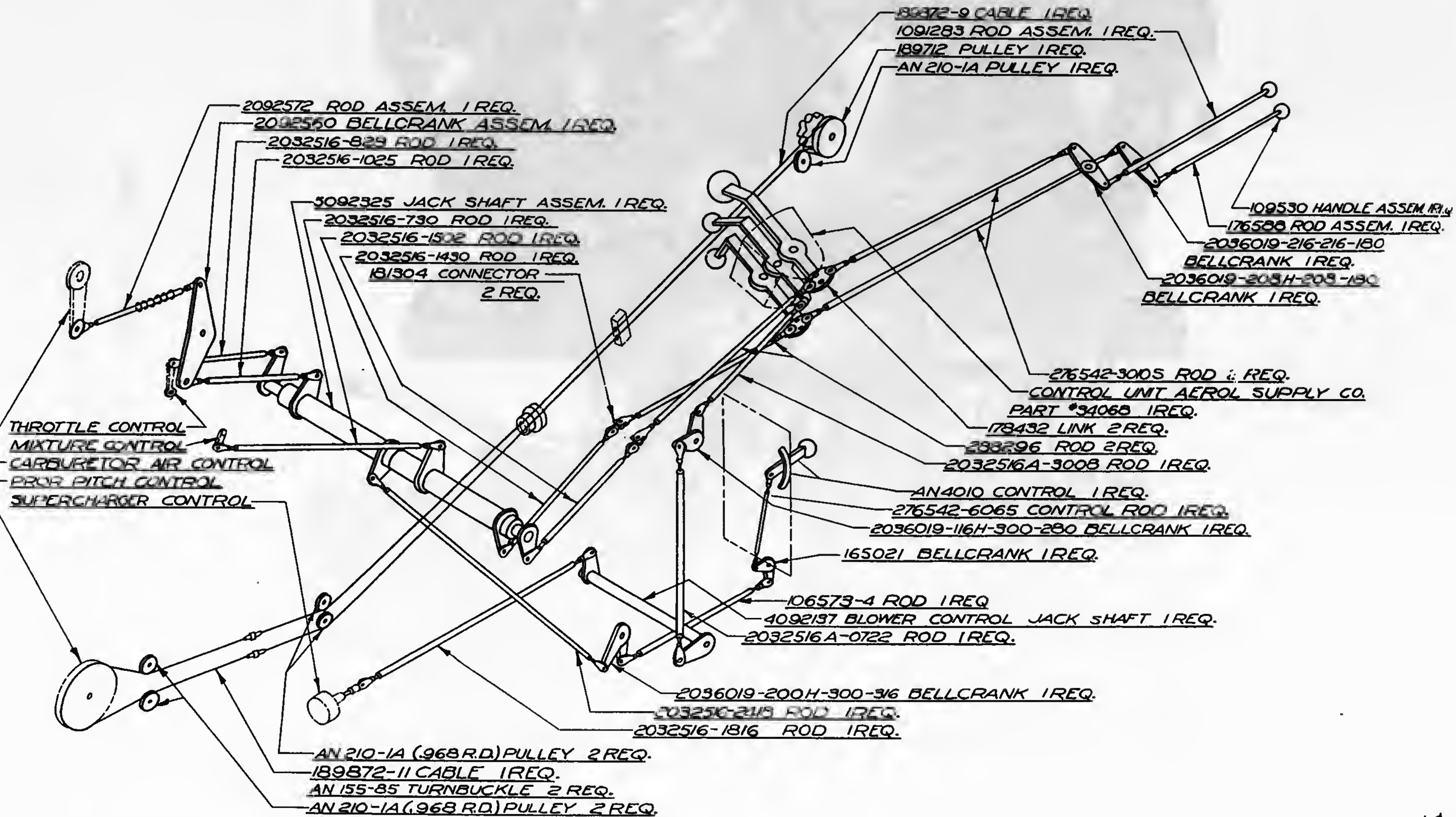


ENGINE MOUNT ABSORBER INSTALLATION

1. Coat parts with castor oil before assembly.

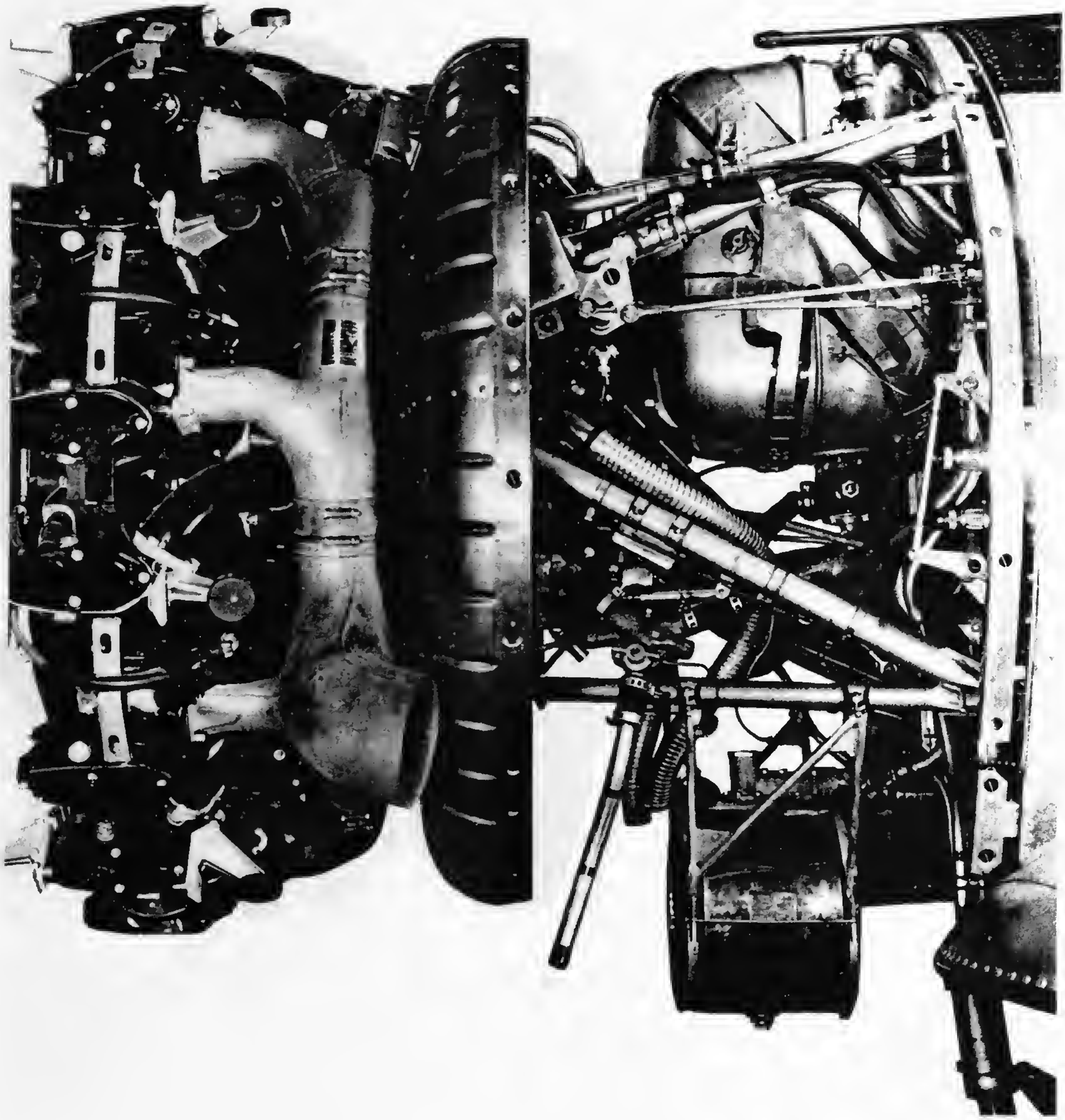
2. When placing the engine attaching bolt in position be sure that the cotter pin hole is properly located to receive the cotter pin.

3. While tightening the nut, hold the bolt head firmly to prevent any rotation of the bolt. Do not tighten the nut by rotating the bolt. To do so may rotate the dural spacer and tear the rubber absorbers.

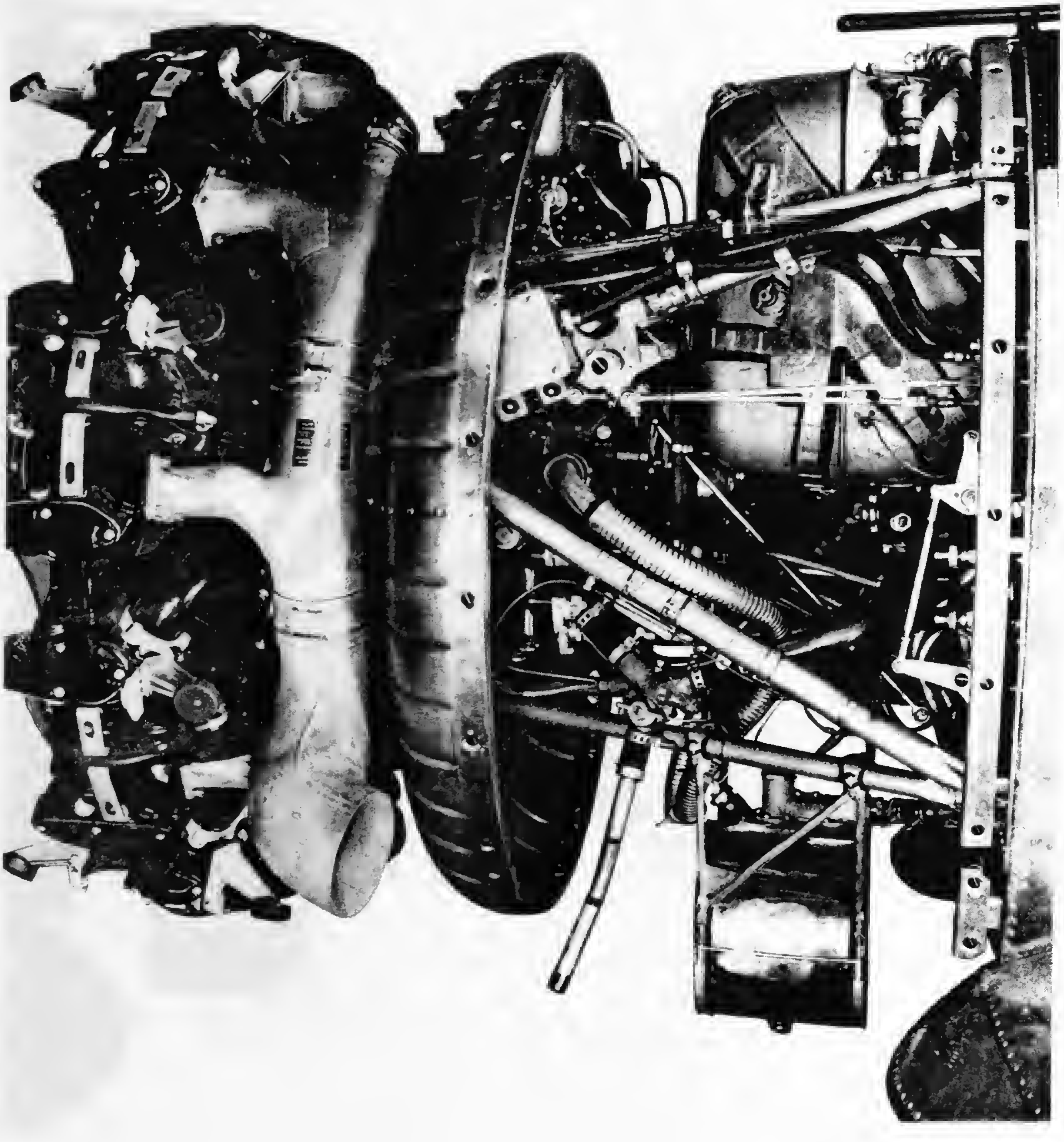


REFER TO DOUGLAS DWG.
NOS. 5091150 & 5091151

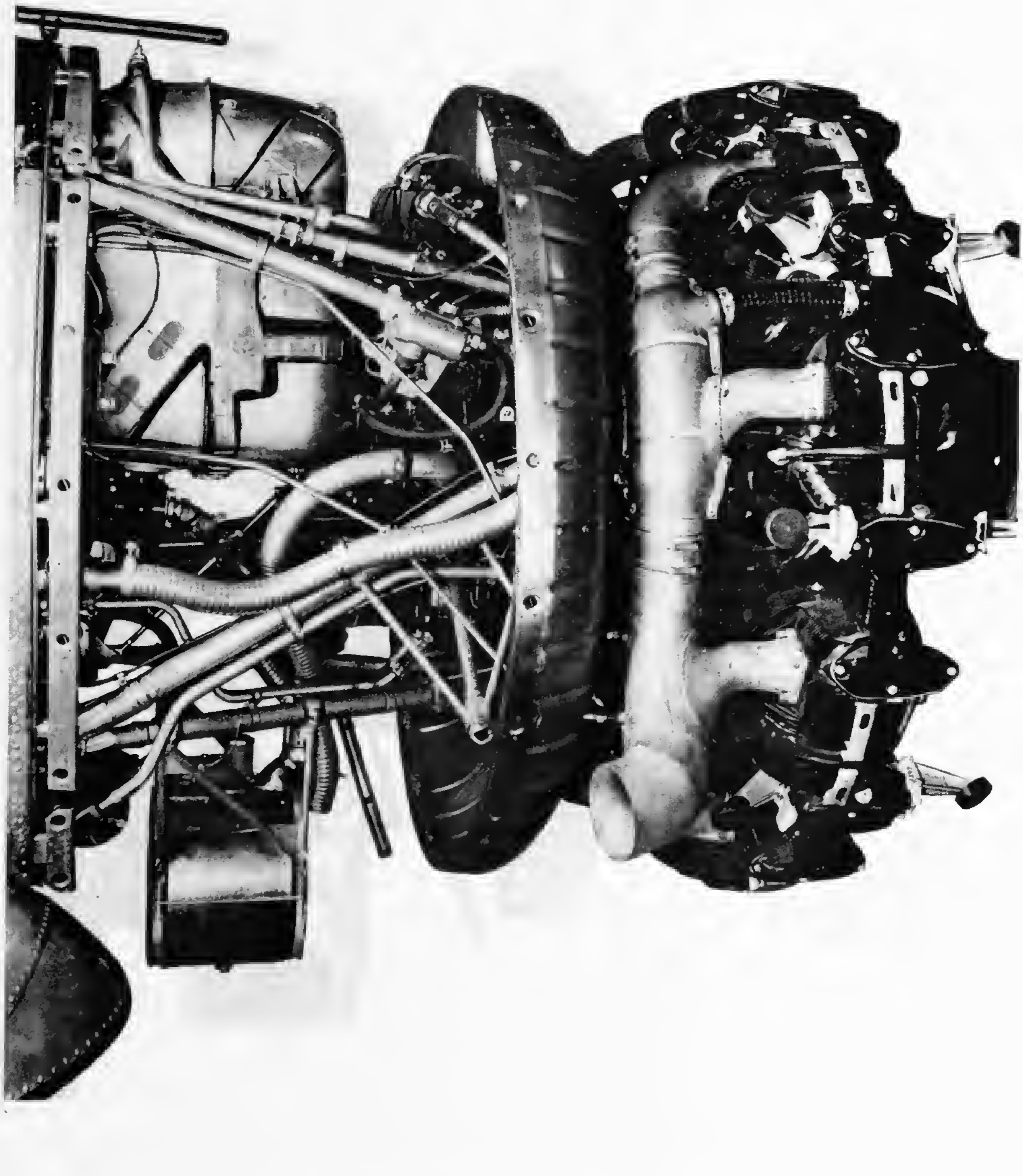
ENGINE & PROPELLER CONTROLS



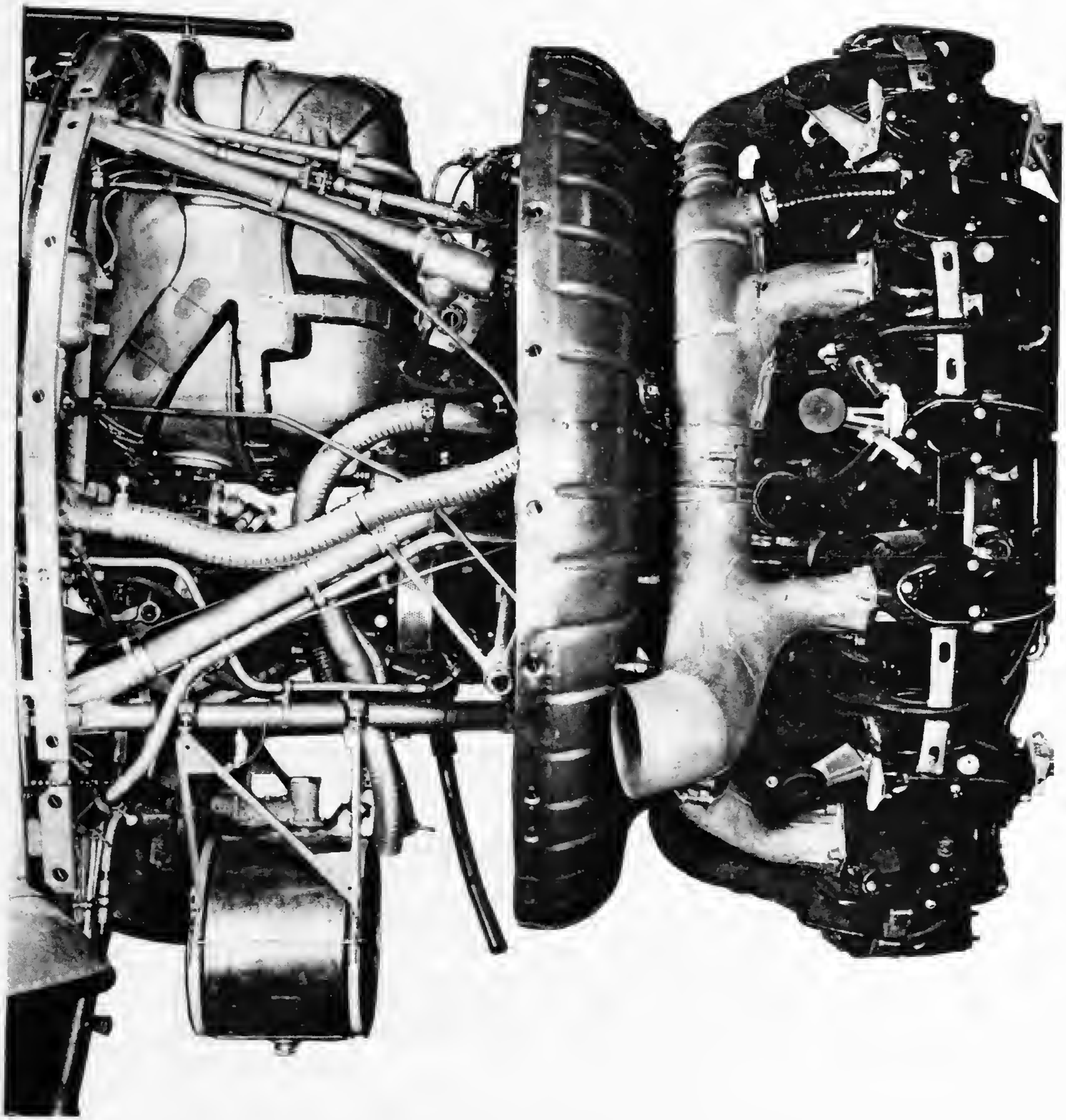
8306 - Engine - Lower Left



8309 - Engine - Upper Left



8307 - Engine - Upper Right



8308 - Engine - Lower Right

SECTION IX

Title

ENGINE ACCESSORY SECTION

A. DESCRIPTION

1. The engine is attached to the engine mount by nine nickel steel bolts, with rubber bushings to absorb vibration.

2. The engine mount is a chrome molybdenum steel tube frame welded into a single unit, to which lugs are welded for attaching the engine The complete assembly of mount, engine and accessories is bolted to the firewall by four nickel steel bolts.

3. The oil radiator is supported by a bracket attached to the lower truss members of the engine mount. It is supported partially below the cowling contour so as to be in the direct slip stream and is well faired into the cowling.

4. The oil tank holds approximately 26 U S. gallons (101 liters), has an additional expansion space of 3.3 U.S. gallons (12.5 liters) and is mounted on well padded dural straps which in turn are attached to the engine mount upper truss members.

5. (a) The cowling is divided into three sections: First the anti-drag ring which covers the engine, second the diaphragm which protects the engine accessory section from excessive engine heat, and third the engine accessory cowling which houses the rear section and which has an air scoop for cooling the oil and magnetos.

   (b) The anti-drag ring is the modified anti-drag type as approved by the National Advisory Committee for Aeronautics and is made in three easily detachable units; the top and two lower segments. It is supported by pads attached to inner surface of cowling, which seat on fittings bolted to the attaching lugs on the engine rocker boxes. The assembly is held in place by Dzus fasteners and four trunnion bolts. The carburetor air scoop is built integral with the cowling.

   (c) The diaphragm is located aft of the engine and is bolted to and between the engine and the engine mount, using the engine mounting lug bolts to attach all three together. The diaphragm protects the accessory section from engine heat and acts as a baffle in case of fire. Top and bottom sections are shaped to accomodate air ducts to carburetor, magnetos and oil radiator.

(d) <u>The engine accessory cowling</u>, aft of the ring cowling, entends from its attachment on the aft edge of the diaphragm to the firewall and houses the engine accessories. It is constructed of aluminum alloy sheet and is divided into four units. The lower section is shaped so as to form an air duct which serves the oil radiator and magneto cooler tubes.

B. INSTALLATION

1. Engine Mount Assembly

(a) This assembly consists of the mount to which is attached the engine and all its accessories, except the propeller and the anti-drag and accessory cowlings. These are installed or attached later. To install the assembly have the fuselage in a level position. Attach a sling to the engine by removing the rocker arm hub bolts nuts from the exhaust rocker arm bolt of #2 cylinder and the intake rocker arm bolt of #9 cylinder, and replace these nuts with the attaching plates installed over the round portion of the nuts. <u>Place spreader bar in its proper position in the sling</u> to avoid damaging engine connections. Hoist assembly and move to position at forward end of fuselage

(b) Align the attaching bolt holes in the engine mount with those in the fuselage.

(c) Screw in attaching bolts tightly and secure with safety wire.

(d) Connect up electrical connections, engine controls, fuel, oil and instrument lines.

(e) See Section VIII for installation of engine on the engine mount

2. Anti-drag Ring Cowling

(a) This is installed by placing the top section on first. Next the two lower side sections. When placing each section, fit the inner support pads carefully over the tops of engine rocker boxes. Fasten the two lower sections to the upper with Dzus fasteners and by tightening up the trunnion bolts, draw all three sections together.

<u>CAUTION</u>: Pull up cowling snug with engine cold Do not try to bring new cowling tightly together at the bottom, to do so may warp the whole cowling out of shape.

3. The Diaphragm

(a) Installation on the engine is made in two sections and at the same time the engine is attached to the mount. See page VIII - 2.

(b) The upper half of the diaphragm is placed in position over the upper aft end of the engine and the lower half of the diaphragm is bolted to it.

(c) Line up lug holes on engine with those on the diaphragm and engine mount, placing inner diaphragm or pan between the engine under rubber bushing and next to mount.

(d) Adjust washers, bushings, and spacers, then bolt all three assemblies together with engine mounting lug bolts.

4. Engine Accessory Cowling

(a) This cowling is made in sections, and should be installed one section at a time. All are held in place by Dzus fasteners.

(b) Place the forward end of the bottom section over the aft end of the diaphragm, and the aft end of the bottom section on the formers on the firewall. Secure with Dzus fasteners.

(c) Connect the leads from the magneto cooling tubes to the nipples on the inner side of the air duct.

(d) Side and top sections can now be installed by placing forward ends of cowling over aft end of diaphragm and the aft ends of cowling over the formers on the firewall. Secure all with Dzus fasteners

C. REMOVAL

1. Anti-drag Ring Cowling

(a) This cowling should be removed by releasing the trunnion bolts and unfastening Dzus fasteners. Remove the two lower sections, then lift off the top.

2. Engine Accessory Cowling

(a) Unfasten Dzus fasteners and lift off top sections

(b) Unfasten Dzus fasteners and remove both side sections of cowling.

(c) Disconnect the leads from the magneto cooling tubes to the nipples in the air duct of bottom section of cowling.

(d) Unfasten Dzus fasteners on bottom section of cowling and remove from airplane.

3. Engine Mount Assembly

(a) First remove propeller, then ring and accessory cowling, as instructed above. For removal of propeller see Curtiss Electric Propeller, Installation and Maintenance Instructions Manual.

(b) With the fuselage in a level position, attach a sling to the aft hoisting rings on engine housing, place spreader bar in its proper position in the sling over the two aft rings, to avoid damage to engine connections. Attach a third line from hook on hoisting rig, forward to propeller shaft for balance.

(c) Hoist until weight of engine and accessories is taken up by the sling.

(d) Disconnect all electrical connections; engine controls; fuel, oil and instrument lines.

(e) Remove cowling formers from firewall where necessary to provide space to remove the four bolts attaching assembly to fuselage.

(f) Loosen and remove the four bolts attaching assembly to fuselage.

(g) Swing clear of fuselage

4. The Diaphragm

(a) Diaphragm can be removed in sections This is readily understood by inspection It is necessary, however, when complete removal is needed (such as the inner baffle or pan) to remove engine from mount. See page VIII - 3

D. MAINTENANCE

1. Anti-drag Ring Cowling

(a) Check daily for loose brackets, fittings and safety of trunnion bolts. Check support pads for wear or replacements.

2. The Diaphragm

(a) Check daily. Tighten loose bolts or fasteners.

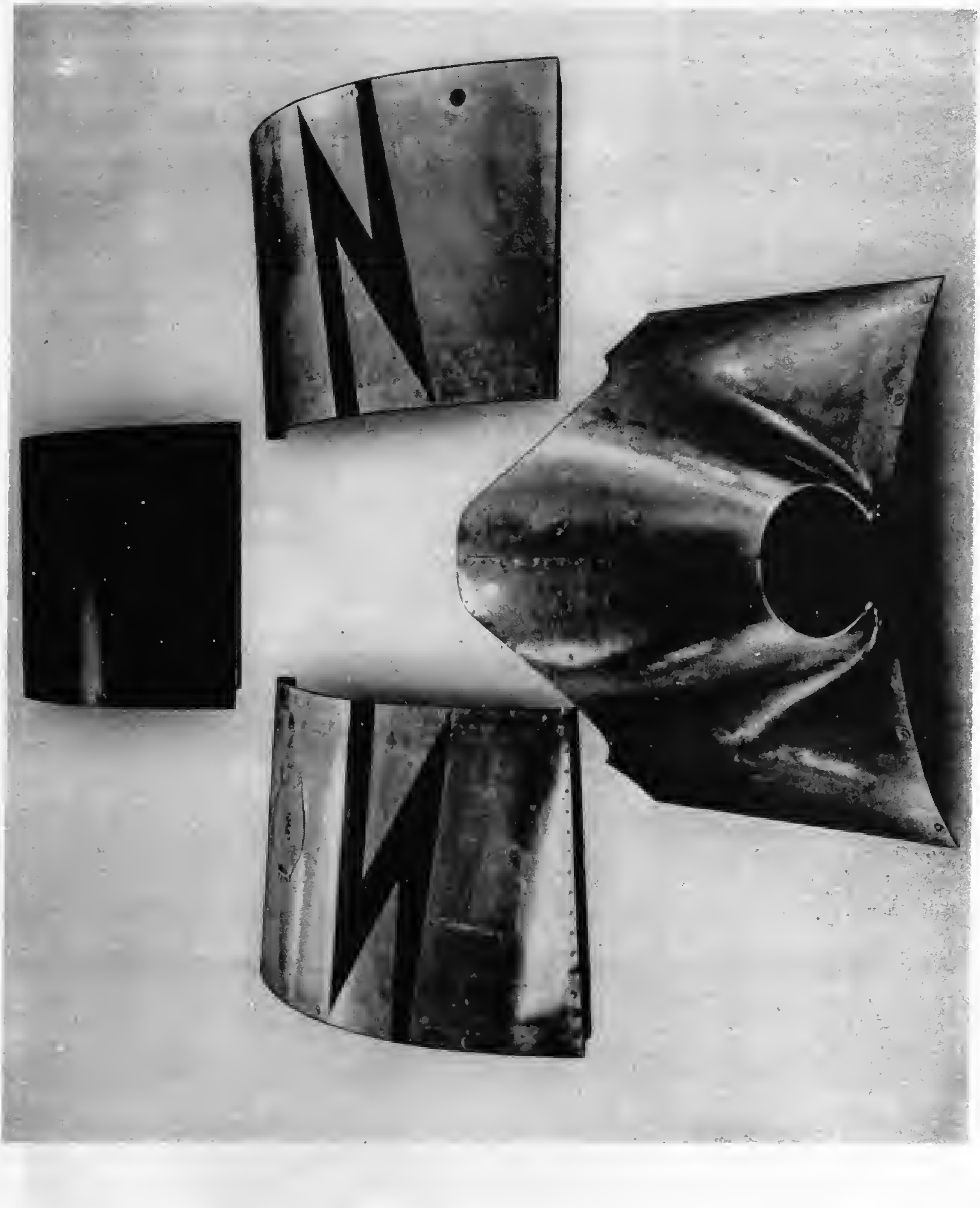
3. Engine Accessory Cowling

(a) Check daily for loose fittings, supports or worn pads.

4. See Section XXIII for further maintenance information.

1. Carburetor Air Intake Scoop
2. Engine Pad Receptacles
3. Air Intake Door
4. Trunnion Bolts
5. Exhaust Collector Ring Port

8228 - Engine Cowling Assembly



8329 - Accessory Compartment Cowling Assembly

5598 - Engine Cowling Adjustment Links

8312 Cowling Installation - Right Side

8242 - Cowling Installation - Left Side

SECTION X

FUEL SYSTEM

A. DESCRIPTION

1. General

(a) The fuel system consists essentially of six tanks, located in the center section of the wing; two four-way selector valves and control assemblies, hand pump with strainer, by-pass and pressure relief valve, engine-driven fuel pump, fuel pressure gage and lines, primer, fuel quantity gage and selector switch, and the necessary lines and fittings.

(b) All fuel supply lines from the fuel tanks to the carburetor are of 5/8 inch (15 mm.) O.D. aluminum tubing. Primer lines are of 1/4 inch (6.3 mm.) O.D. aluminum tubing, and the fuel tank vent lines are of 3/8 inch (9 mm.) aluminum tubing. The engine-driven fuel pump is vented to the carburetor through a 1/4 inch (6.3 mm.) O.D. copper tubing, and the line from the pressure warning switch to the firewall is of 1/4 inch (6.3 mm.) O.D. copper tubing. All fuel and vent lines are marked with a band of yellow paint near each end and at intervals along the tubing so that they may be distinguished from other tubing.

2. Tanks

(a) The fuel supply is carried in six tanks located in the center section of the wing. Three tanks are on the left side of the fuselage and three on the right side. The left front tank carries the reserve supply of fuel.

(b) The fuel tanks are constructed of 52 SO aluminum. The following chart shows thickness, in centimeters, of material used:

	Front Tanks		Center Tanks	Rear Tanks
	Left	Right	Both	Both
Outboard End	.130	.130	.130	.102
Inboard End	.130	.130	.130	.102
Shell	.163	.102	.183	.102
Baffles	.102	.102	.102	.102

The chart above may be of use if ever it is necessary to repair the tanks by welding.

(c) The baffles are spot welded to the outer shell. There are seven baffles in each front tank, two in each center tank and five in each rear tank. The end bulkheads and lengthwise seams are torch welded.

(d) Flanges are welded to each tank to provide for the filler neck, quantity gage, sump and line connections.

(e) The tanks are pushed into the spaces formed by the webs and the upper and lower skin of the center section. The tanks are well padded with felt strips at the points of contact. The wing joint bulkhead prevents the tanks from shifting.

3. Fuel Capacity

(a) The total fuel tank capacity is 252 gallons (688.8 liters), divided as follows:

	Gallons	Liters
Left Front Tank (Reserve)	54.5	206.3
Right Front Tank	57.5	217.6
Two Center Tanks (each)	49.5	187.3
Two Rear Tanks (each)	20.5	77.6

4. Fuel Valves

(a) There are two type G2-A fuel valves operated by remote control from the pilot's cockpit. The reserve fuel is clearly marked on the valve control panel in the pilot's cockpit.

(b) Due to variations in the height of the fuel tanks when the airplane is on the ground and to unavoidable differences in the dynamic pressures in the vent lines when in flight, it is always preferable to operate from one tank at a time. If simultaneous operation of two tanks is essential, the fuel must be drawn from pairs of tanks, i.e., from the two front tanks, the two center tanks or from the two rear tanks and the pilot must check frequently the fuel level in the tanks from which the fuel is being drawn.

5. Location of Valves, Pumps and Strainer

(a) The fuel valves, wobble pump with integral strainer and relief valve are located between and are accessible through the wheel wells. The engine-driven fuel pump is attached to the right aft side of the engine accessory drive case.

B. INSTALLATION

1. Fuel Tanks

(a) Remove the filler neck caps from the top of the tanks, and fuel line outlet flanges from the bottom.

(b) Place thin sheet metal guide strips, about 4 feet (1.21 m.) long and 4 inches (10 cm.) wide, on the felt pads and insert the tank into the center section. The guide strips may be removed after the tank has been inserted about three quarters of the way. Then insert tank remainder of distance. Repeat this operation for each tank. See page X - 8.

(c) Replace filler caps and flanges.

(d) Connect the gage lines and the bonding strips.

(e) Connect the vent lines on the top of the tanks and the fuel lines to the bottom. See Fuel System Diagram, page X - 7.

NOTE: Be sure that the webbing removal strap, one on each tank, is securely in place before the tank is installed.

(f) Install fuel line fairing.

C. REMOVAL OF THE FUEL TANKS

1. Remove wings. See Section IV, E.

2. Remove the wing attaching bulkhead.

3. Remove fairing and disconnect fuel lines from the under side of the center section.

4. Remove the pipe fittings from the flanges on the under side of the tank. Remove the flanges.

5. Disconnect the vent lines from the tanks. These will be found just inside of the fuselage, directly over each tank.

6. Disconnect the bonding strips at the tanks and the electric wires from the fuel gages.

7. Pull tanks out by the webbing removal straps provided for this purpose.

D. REMOVAL OF VALVES, WOBBLE PUMP & STRAINER

1. The fuel valves, wobble pump and strainer, and the fuel pump may be removed by first disconnecting the lines and removing their respective bolts

2. All except the fuel pump, which is on the engine, are accessible through the wheel wells and Dzus fastened door beneath the center section.

E. MAINTENANCE

1. To Fill Tanks

(a) Refer to Section III, F.

2. To Repair Tanks

(a) The tanks may be repaired by welding.

NOTE: A tank requiring repairs by welding or by use of an open flame, should be drained and thoroughly cleaned before such repairs are attempted. A method used by the U.S. Army Air Corps is suggested, as given below.

(1) No repairs requiring the application of heat should be accomplished on fuel or oil tanks while installed in the airplane.

(2) The tank should be flushed for fifteen minutes with hot water admitted at the bottom of the tank and allowed to overflow at the top. This is to remove deposits of oil or fuel adhering to sides of the tank.

(3) After flushing with water, the tank should be cleaned with live steam. Allow the steam to pass through the tank for a minimum period of 3 hours for fuel tanks, and for a minimum period of 1 hour for oil tanks. The live steam being fed in at the top opening and allowed to escape through the bottom opening: All other openings should be closed.

(4) If facilities for steam cleaning are not available the flushing with hot water referred to in E, 1, (a), 2, should be continued for a period of one hour, following which the interior of the tank

should be thoroughly dried with compressed air. This is not as positive a method of removing combustible material and fumes as the steam cleaning; therefore, it should not be used unless absolutely necessary.

(5) When the exterior of the tank is to be cleaned with paint remover, or any other combustible solvents, this cleaning should be done prior to the flushing and steaming of the interior of the tank.

(6) The repair work should be accomplished as soon as possible after the tank has been cleaned and dried. Under no circumstances should a tank that has been flushed and steam cleaned and dried be allowed to stand more than 30 minutes before being repaired. Tanks that are allowed to stand in excess of this period should be recleaned before applying any heat.

(7) Tanks that have contained fuel or oil should not be welded near any combustible material or in a building containing such materials.

3. Leakage

(a) Inspect the fuel system every ~~20 hours~~ day ([illegible]) for leaks. Leaks in the suction side of the system are the most serious as they are apt to cause loss of prime or failure to prime when starting the engine. Unless these leaks are of considerable size, they will not show up when the engine is running. The following procedure for routine examination of fuel leakage is recommended:

(1) Fill tanks.

(2) Remove fairing under the center section and examine all outlet line connections to the fuel control valves.

(3) Examine fuel control valves, strainer caps and drains, hand pump gland, by-pass and relief valve caps and all of the connections involved.

(4) The line from the hand pump to the engine-driven pump should be tested by pumping up the fuel pressure by hand.

4. <u>Cleaning</u>

(a) The sump on each fuel tank should be drained daily from the small drain cock to remove all collected dirt and water. Weather head drains are accessible through small doors in the fairing below each tank.

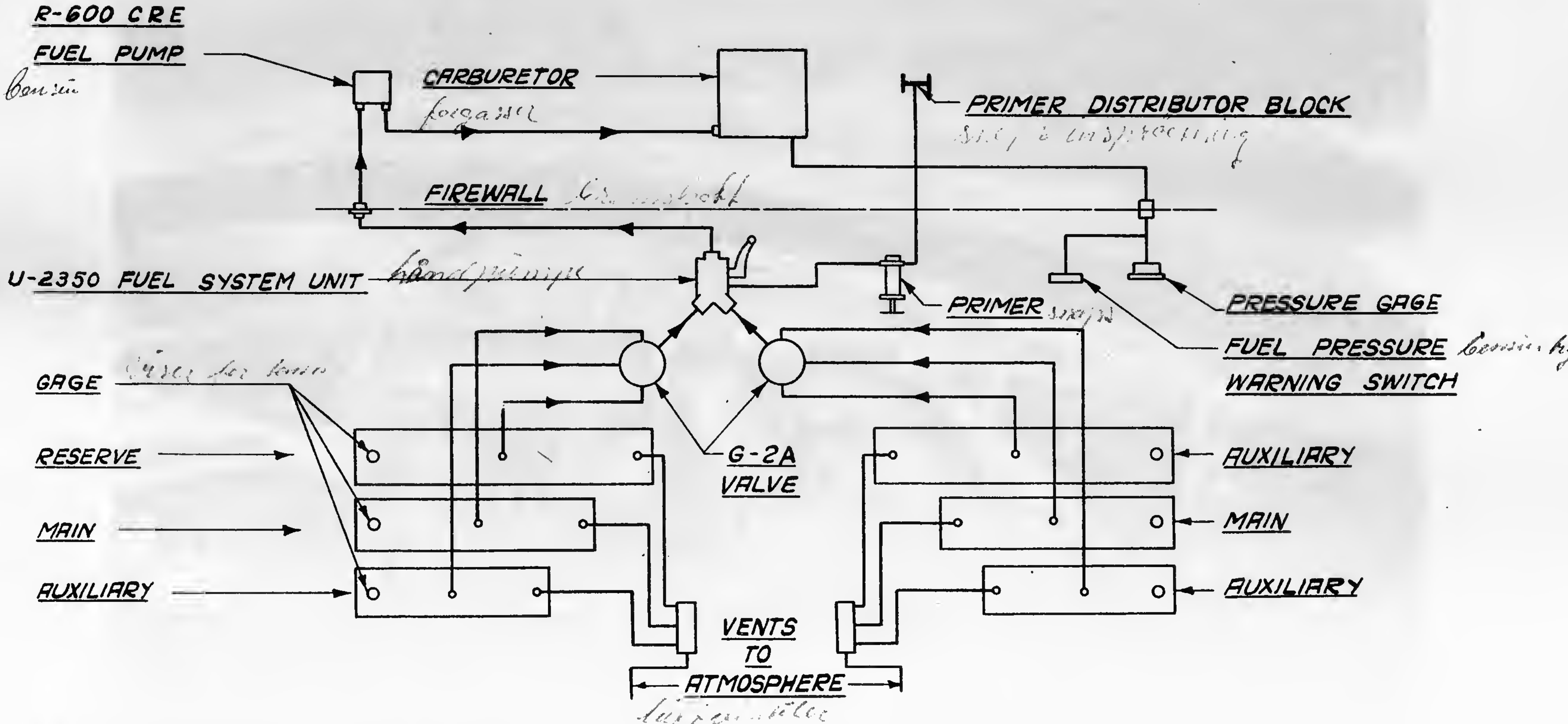
(b) Access to weather head drain cock and fuel strainer unit of hand fuel pump, is gained through door in fairing between landing gear wheel wells.

(c) For rapid draining of the fuel tanks and lines, remove the large drain plugs. These are located beside the small drain cocks, and they support the finger screens which should be removed for cleaning each time the tanks are drained.

<u>NOTE</u>: In order to drain the complete system, the drain plugs must be removed from all tanks. The airplane should be in the three point position.

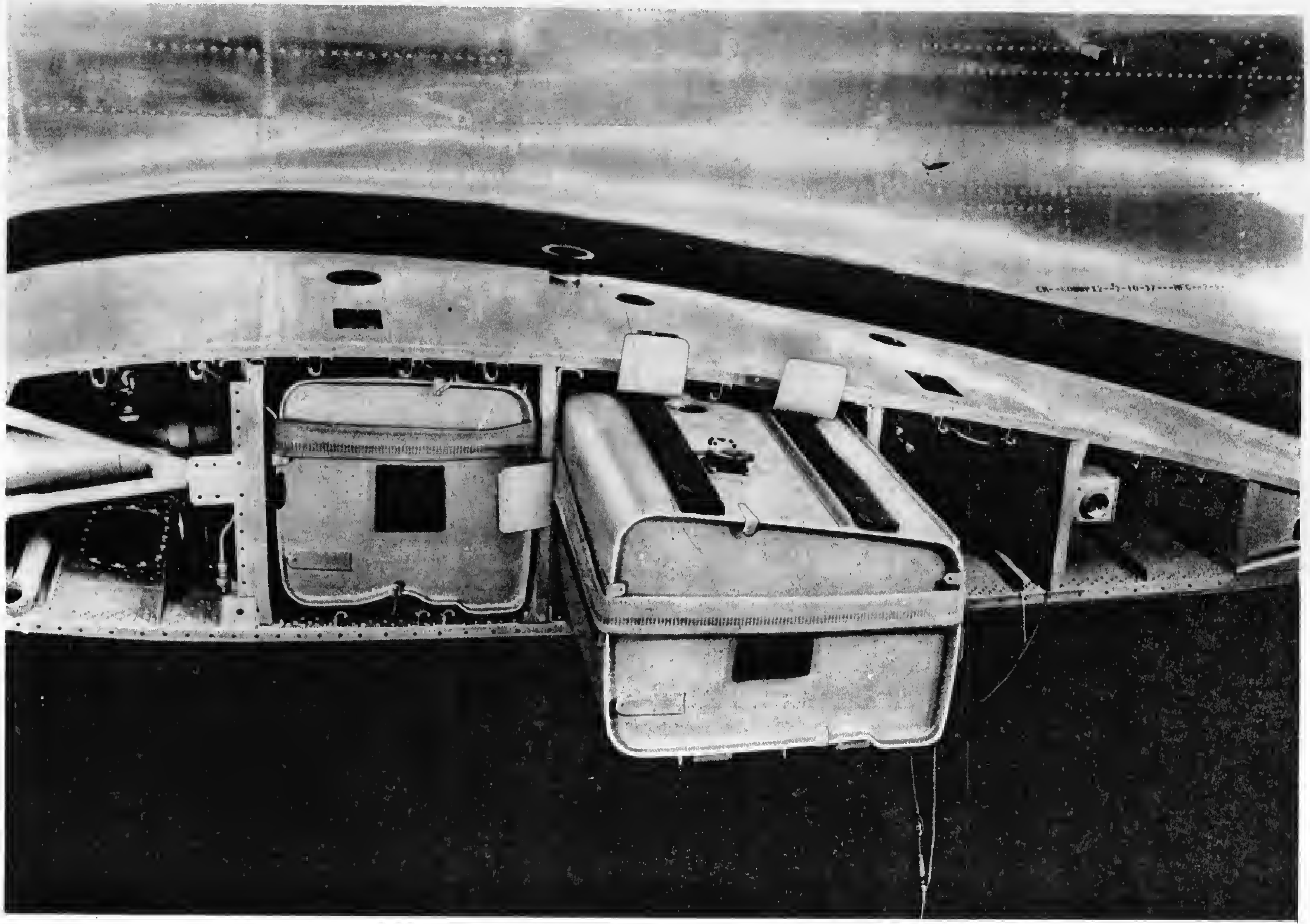
<u>CAUTION</u>: Aluminum alloy threaded parts will seize and gall when threaded together with pressure. This is particularly so when fuel line fittings are assembled moist with gasoline. Apply lubricant to the aluminum alloy threaded parts before assembling. See note on pg. XXIII-28.

(d) See Section XXIII for additional maintenance information. See page XXIII - 28 for lubrication of the wobble pump control.

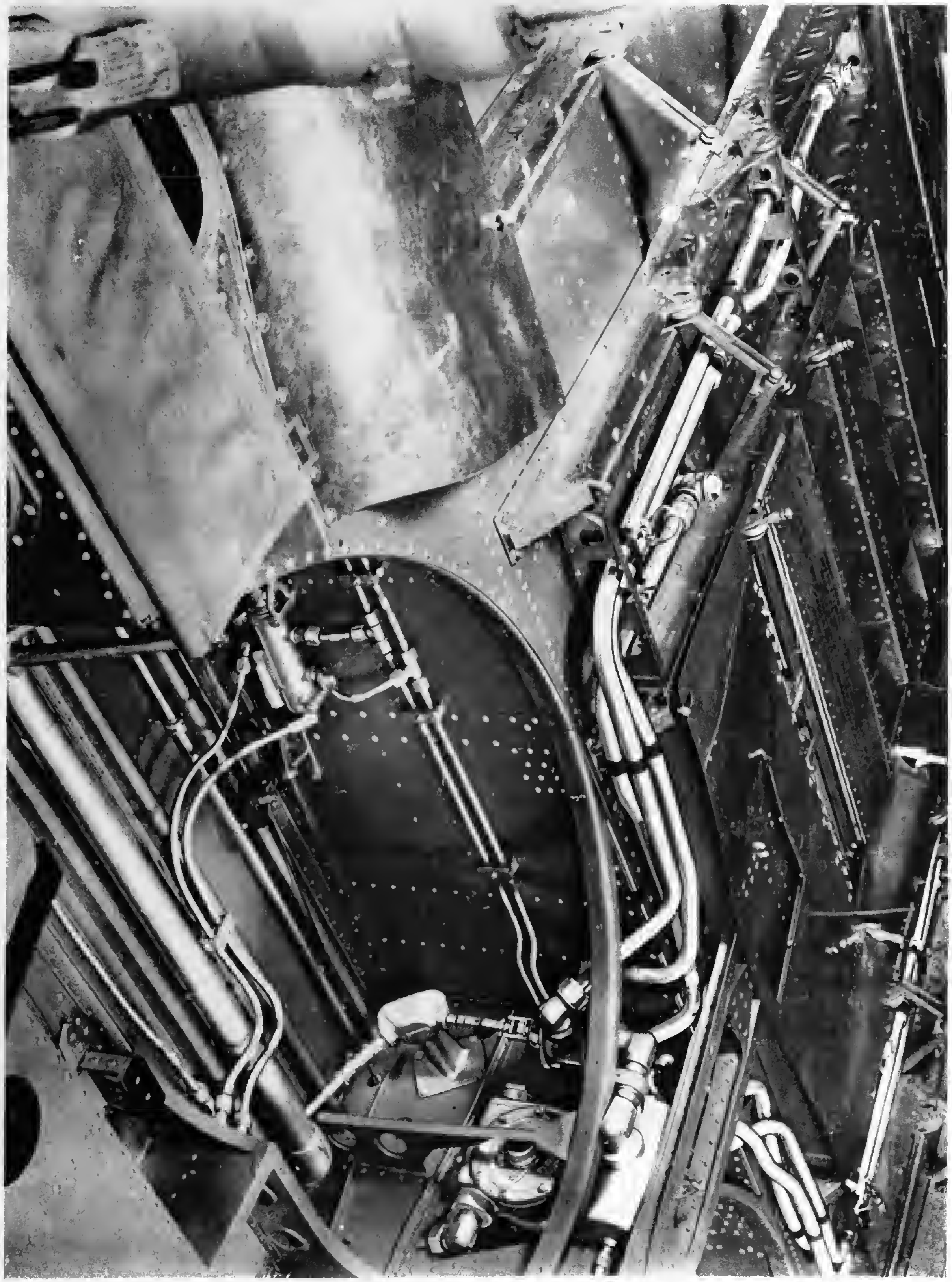


TANKS 688.8 LITERS MAX. CAPACITY
REF. DWGS. # 579130, 5056625-500,
& 579010

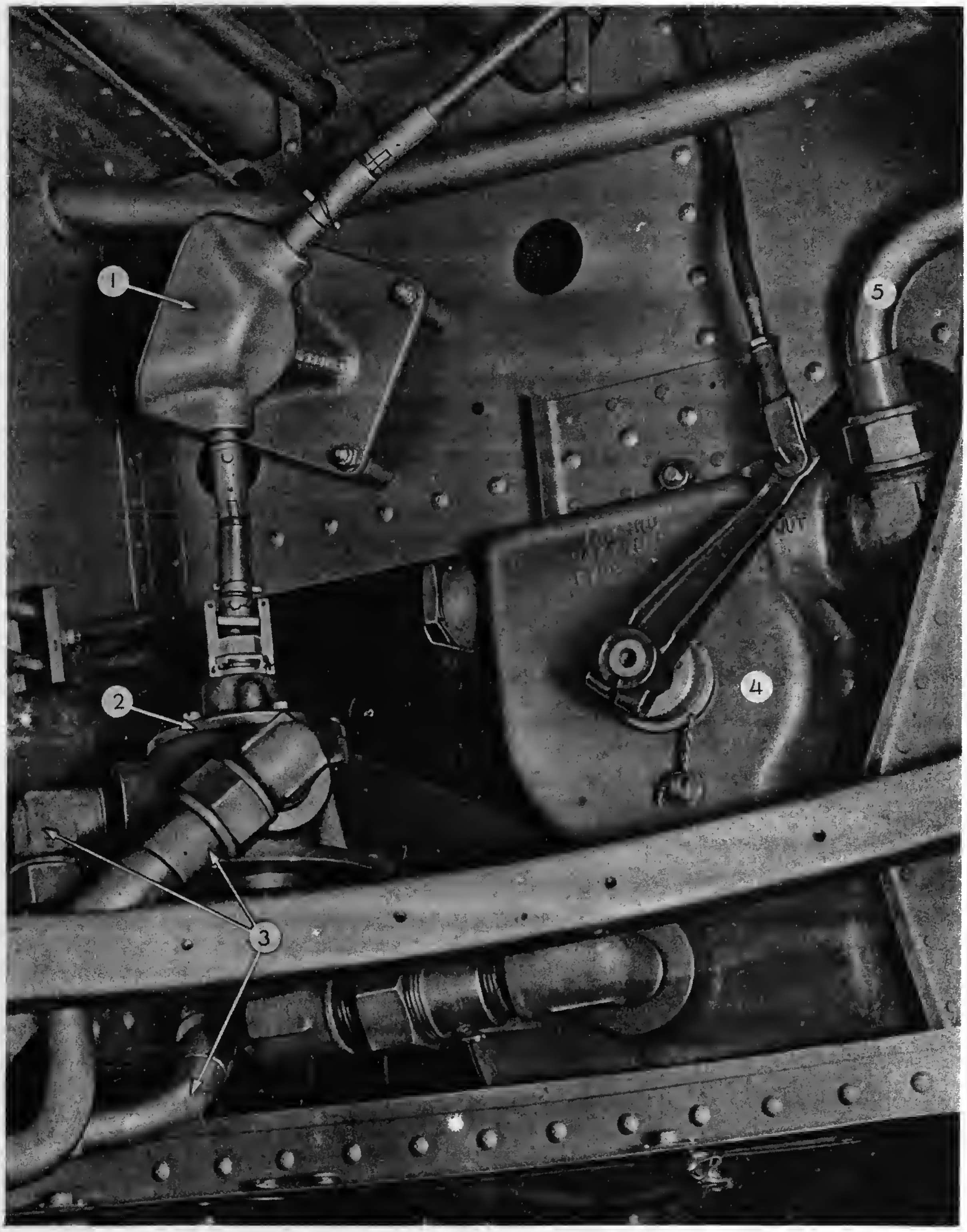
FUEL SYSTEM DIAGRAM
FOR MODEL 8A-5



5367 Fuel Tank Installation



8266 - Fuel Lines Installation

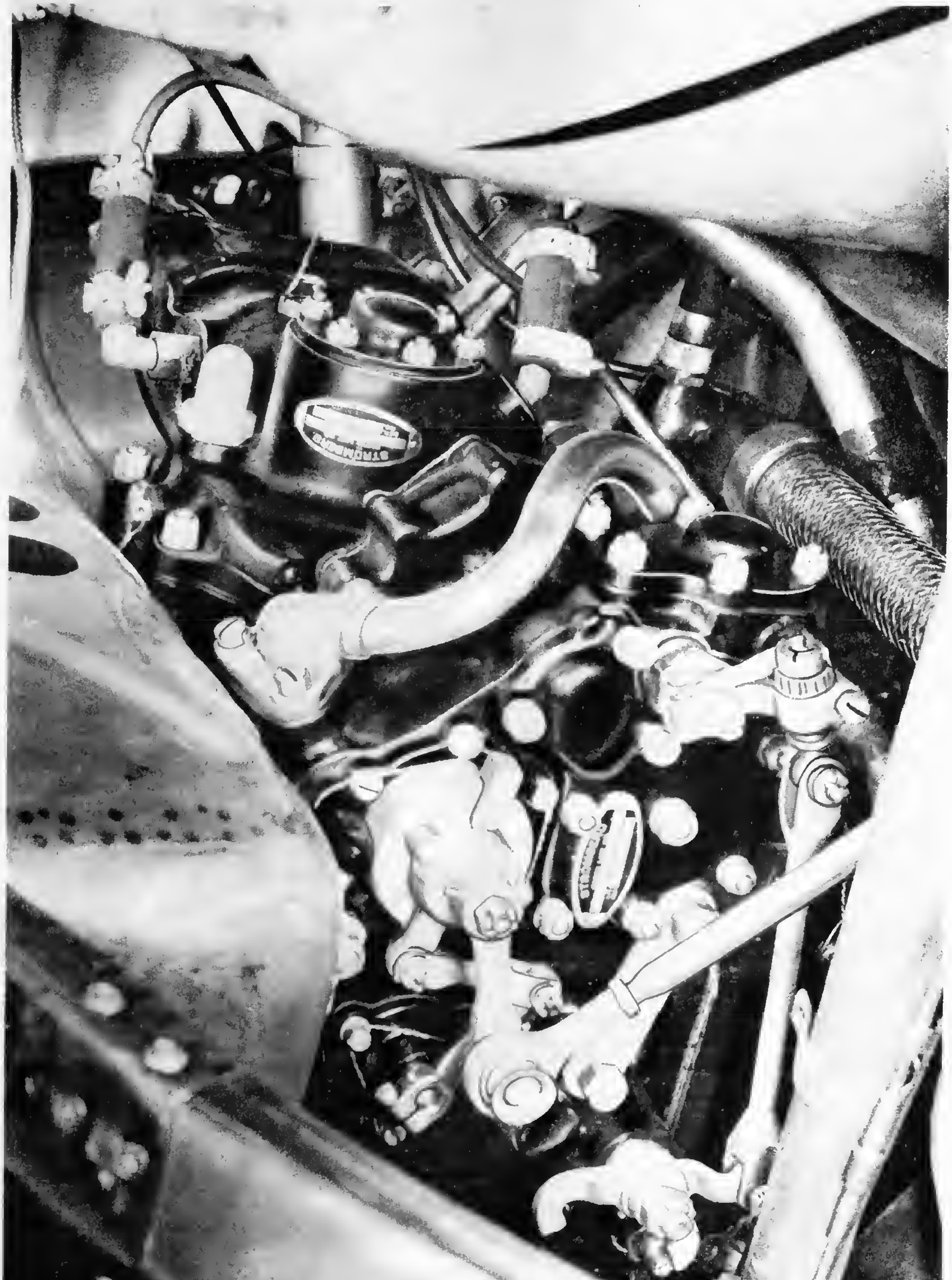


1. Fuel Valve Gear Box
2. Fuel Tank Selector Valve
3. Fuel Lines from Tanks
4. Wobble Pump
5. Fuel Line to Engine

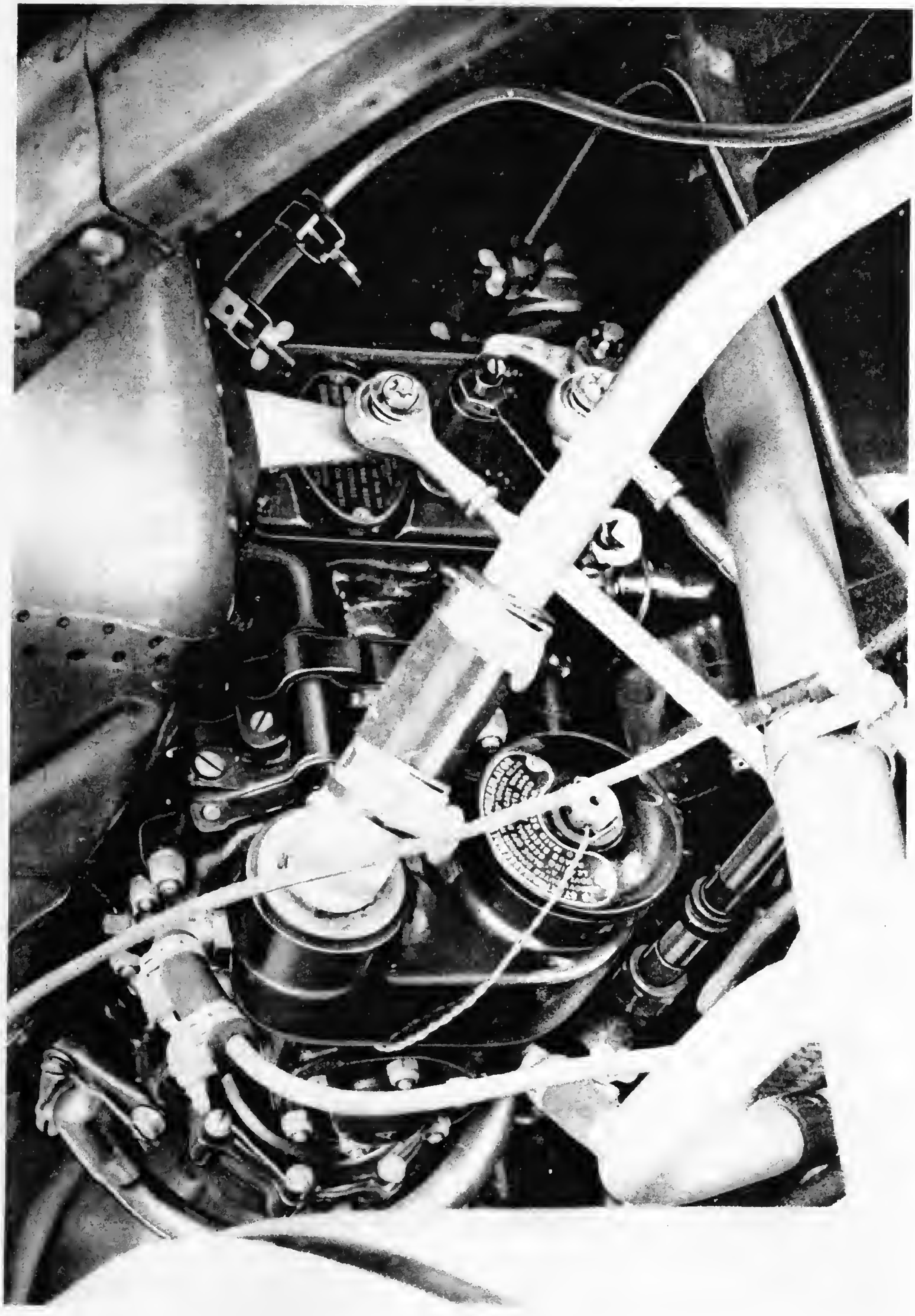
8219 Fuel Valve and Wobble Pump, Left Wheel Well

1. Fuel Valve Gear Box
2. Fuel Tank Selector Valve
3. Fuel Lines from Tanks
4. Wobble Pump
5. Fuel Line to Engine

8220 Fuel Valve and Wobble Pump, Right Wheel Well



8217 - Carburetor, Left Side



8218 - Carburetor, Right Side

SECTION XI

OIL SYSTEM

A. DESCRIPTION

1 General

(a) The oil system consists essentially of a 26 U.S. gallon (101 liters) tank, approximate capacity; "Y" drain cock; oil pump (integral with engine); strainer; pressure gage; automatic temperature control valve to direct oil to tank or to cooling radiator with pressure relief valve, and the necessary lines and fittings

2. Lines

(a) All of the supply, return and drain lines are of 1 inch (2.54 cm.) O D. aluminum tubing, except the line from tank into engine which is 1-1/4 inch (3.1cm.) O.D. The overflow and vent lines are of 3/4 inch (1.9 cm.) O.D. aluminum tubing, and the pressure gage line is of 1/4 inch (.6 cm.) copper tubing. All oil lines are marked with a band of brown paint near each end and at sufficient intervals along the tubing to facilitate tracing the lines.

3. Flow

(a) The oil flows from the tank past the "Y" drain cock and into the engine. After it circulates through the engine, it passes through the automatic temperature control which directs cold oil into the tank or hot oil into the oil cooler and which in turn circulates oil into the jacket encircling the oil cooler, around the pressure relief valve, then through the outlet and up into the oil tank. Incorporated in the oil cooler is a pressure relief valve, which, in the event of congealed oil or other obstruction in the oil cooler, will by-pass the oil through the relief valve and to the oil tank.

4. Tank

(a) The oil tank has an approximate filling capacity of 26 gallons (101 liters), and a 3.3 gallon (12.5 Liters) expansion space. The tank is not painted. Flanges are welded to provide for the filler neck and line connections. The tank is held in place by a padded aluminum alloy fitting assembly which is attached to the engine mount.

Aluminum alloy straps attached to the fitting assembly secure the tank in position. Turnbuckles are provided to adjust the tension in the straps. A petcock is provided above the horizontal centerline of the tank. If petcock is left open during filling operation of the tank, it will act as a gage in that oil will flow out of the petcock when approximately 17 gallons (64 liters) have entered tank.

5. Filters

(a) The oil filter is located on the left side of the rear crank case section, just below the horizontal centerline of the engine. It may be detached for cleaning by removing the six nuts which hold it in place.

B. INSTALLATION (Ref. Dwg. #5091127 - Installation, Oil System)

1. Oil Tank

(a) Attach the cradle assembly to the oil tank.

(b) Remove upper section of cowling former and place the tank in position.

(c) Bolt the cradle supports to the brackets attached to the upper engine mount tubes.

(d) Make all line connections. Refer to drawing #5091127, Installation, Oil System.

(e) Connect bonding strips and replace cowling former.

C. REMOVAL

1. Oil Tank

(a) Remove the side and top sections of the engine accessory cowling.

(b) Drain oil.

(c) Disconnect all line connections at the oil tank and plug the openings in both the tank and the tube lines.

(d) Disconnect bonding strips.

(e) Remove the upper section of cowling former.

(f) Remove the four bolts through the cradle attaching brackets at the upper engine mount tubes. Refer to drawing #5091127 - Installation, Oil System.

(g) Lift the tank out.

D. MAINTENANCE

1. To Fill Tank

(a) The tank filler neck is accessible through an opening under a hinged cover on the left side near the top of the accessory cowling.

(b) For normal capacity of the tank (17 gallons; 64 liters) open the petcock on the side of the tank, fill to this level then close the petcock.

(c) For full capacity of the tank, (26 gallons; 101 liters) fill to the filler neck.

2. To Repair the Tank

(a) The oil tank may be repaired by welding.

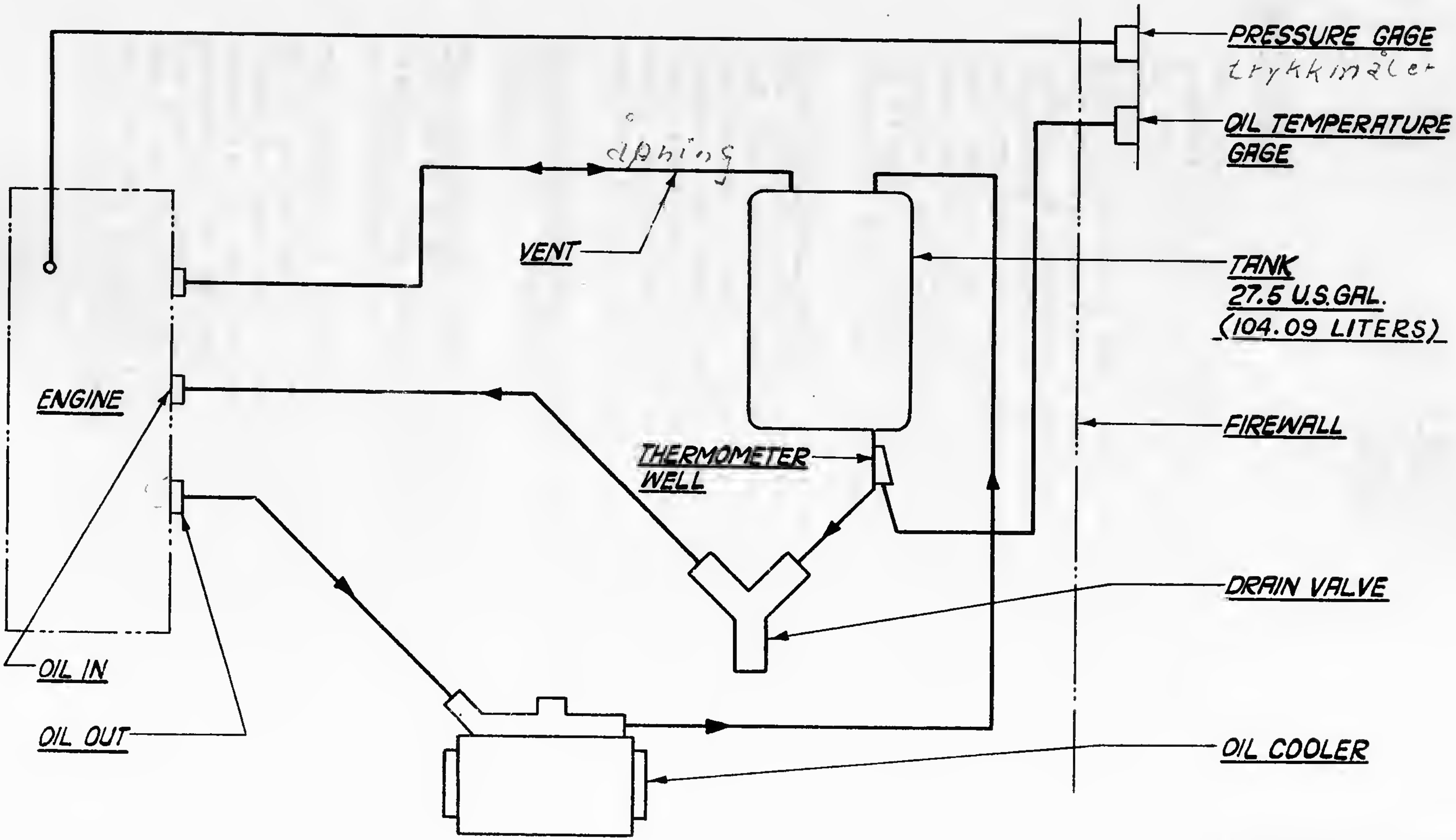
NOTE: Do not attempt to weld the oil tank before completing the cleaning procedure outlined in Section X, E, 2.

3. Inspection

(a) Inspect every 20 hours for leaks in the system and correct operation of the pressure relief valve. See the Wright Instruction Book for adjustment of the relief valve.

(b) The entire system may be drained by turning the handle on the "Y" drain valve and removing the plug from the bottom of the oil cooler.

(c) See Section XXIII for additional maintenance and instructions.



REFERENCE DRAWINGS
DIAGRAM - No 1066026
INSTAL. -

OIL SYSTEM DIAGRAM
MODEL 8A-5

SECTION XII

LANDING GEAR

A. DESCRIPTION

1 The landing gear consists of full cantilever single oleo pneumatic struts rigidly attached to torque shafts, carried by bearings in the center section webs #1 and #2. See page XII - 6. Rotation of the torque shafts retract the gear by swinging the wheels and struts inboard and up into the center section of the wing. The torque shafts are rotated by individual hydraulic operating cylinders, connected to arms on the shafts, the pressure for which is furnished by an engine driven pump, or by an auxiliary hand pump at the right side of the pilot's seat. A control latch, adjacent to the hand pump, unlocks the gear and operates the selector valve for directing the fluid flow to extend or retract the wheels. See Section XIII, and Hydraulic Flow Sheet, on page XIII - 9.

2 A horn warning device, located in the left front corner of the pilot's cockpit, operates when the throttle is closed and the landing gear is in any position except fully extended and locked The horn may be made inoperative by pushing the small handle on the warning switch box at the left side of the pilot's seat. The horn circuit automatically engages when the throttle is opened, so will be operative when the throttle is again closed

3. The shock absorber struts are the conventional oleo pneumatic type, manufactured by the Cleveland Pneumatic Tool Company.

4. The Wheels and tires, streamlined type, are interchangeable, left with right. The tires are 36 inches (91 4 cm.) in diameter. The wheels are equipped with fully enclosed, internal expanding, two-shoe hydraulic brakes.

5 The brakes are operated by individual master cylinders which are connected by a linkage to the brake pedals. Each brake is operated independently from the other. The brake assembly is not interchangeable, left with right. Compensators, or springs, are included in the linkage between the brake pedals and the master cylinders. These springs, which are held in compression when the brakes are locked, obviate the possibility of the brakes becoming loose through contraction of the operating fluid.

B. OPERATION

(Have flap valve in the "LOCKED" position.)

1. To retract the wheels. (Engine pump operating.)

(a) Push back the spring loaded lock, which holds the latch control in the down position, and pull up the lever. Push forward on the thrust rod knob, located just left of the center instrument panel. Hold the knob forward from two to five seconds, thus enabling pressure to build up, then release. When the wheels are fully retracted, red luminous mechanical indicator arms will protrude through the upper skin of the center section over the shock struts. The indicators, clearly visible from the cockpit are a positive indication that the wheels are fully retracted

2. To extend the wheels. (Engine pump operating.)

(a) Push down on the latch control lever, push forward on the thrust rod knob. Hold the knob forward from two to five seconds. When both wheels are locked in the extended position, phosphorus white mechanical indicator arms will protrude through the upper skin of the center section over the shock struts. With the engine idling and the wheels locked extended, the warning horn will cease to operate.

NOTE: Do not continue to hold the thrust rod in the forward position. When the operation is complete, the knob will automatically return to its aft position.

3. Retraction or extension with the engine pump inoperative.

(a) Thrust rod knob must be in its extreme aft position.

(b) Place latch control lever in the desired position, up for retraction, down for extension, and operate the hand pump lever until the landing gear is in its locked position as shown by the luminous indicators.

4. Brakes.

(a) To lock brakes: Press both brake pedals, pull brake lock handle, then release pedals.

(b) To release brakes: Press both brake pedals until brake lock snaps in; release the pedals. If the brakes have been set and locked with sufficient force to completely compress the compensator springs, and a considerable rise in temperature should then occur, the fluid may expand enough to set the brakes so that they cannot be released by foot pressure on the pedals. Should this condition occur, the pressure in the system may be relieved by permitting several drops of fluid to escape from the bleeder valve of each brake.

C. DISASSEMBLY

NOTE: The gear can be disassembled without removal of the wings; however, the removal of the wings greatly facilitates disassembly and is advised. The following instructions will presume leaving the wings on the airplane.

1. Shock strut and torque shaft.

(a) Support the airplane so that the wheels will just clear the ground when fully extended. See Section III, B and C for hoisting.

(b) Remove wheel.

(c) Remove cover plate from leading edge of center section forward of strut.

(d) Remove wheel well fairing, and the hand-hole cover plate in the bulkhead between jack shaft and wheel well.

(e) Drop trailing edge of landing gear fairing door assembly, by cutting lockwire and removing bolt. Next remove cover plate from the lower center section skin.

(f) Take out the retainer bolts at B and remove the links. Remove bolt from the end of the operating piston. See B and C, pages XII -6 and 7.

(g) Remove the four bolts in both the upper and lower brace brackets at web #1 torque tube bearing retainer. Unfasten the bearing brace at A, see page XII -7. The V brace may now be taken out.

(h) Take out the eight bolts in the retainer at web #1, pull the shock strut and torque tube forward slightly, split and remove the bearing and retainer in web #1, then continue forward for complete removal.

2. To remove jack shaft.

(a) Remove the four bolts in retainer at web #1.

(b) Slide jack shaft and retainer forward until the bolt through the forward end of the jack shaft may be removed. Continue forward for complete removal.

3. To remove operating cylinder.

(a) Remove anchor bolt at the piston rod end. See Ⓒ , page XII - 7.

(b) Disconnect the flexible lines from the ends of the operating cylinder. Plug these lines and the holes in the cylinder.

(c) Remove bolts holding the jack shaft eccentric assembly to the large link. See Ⓓ , page XII - 7.

(d) Remove jack shaft.

(e) Remove cylinder and eccentric assembly.

D. MAINTENANCE

1. To service the shock strut.

(a) To check the fluid level. (Check every 20 hours.)

NOTE: The airplane must be resting on the landing gear in the three-point position.

(1) Release the air from the strut by pressing the valve core stem in the valve and filler plug located near the upper end of the strut. See Ⓔ , page XII - 6.

(2) Remove the valve and filler plug.

(3) See that the strut is completely depressed by rocking the airplane. Fill the strut with Lockheed No. 5 hydraulic fluid. (Any other fluid may possibly have a deteriorating effect on the piston packing.)

(4) Replace the filler plug and tighten securely.

(b) To inflate the strut. (Check daily.)

(1) Remove the hex cap from the air valve.

(2) Inflate with air pressure until red line on piston tube is 3 inches (7.6 cm.) maximum with light load, or 2 inches (5.1 cm.) minimum with full load, from end of packing gland nut.

(3) Replace the hex cap and tighten snugly with a wrench.

(4) Check the valve and filler plug for leaks.

(c) For additional information see instruction plate attached to the strut.

2. <u>To service the hydraulic retracting mechanism and brake hydraulic system</u>.

See Hydraulic System, Section XIII.

3. <u>To adjust brake shoes</u>.

(a) Loosen the eccentric lock nut (on the inboard side of the wheel and aft of the axle) and turn the eccentric in the direction of wheel rotation until the wheel is locked. Back off the eccentric until the wheel rotates freely. With a close fitting wrench hold the eccentric in this position and tighten the lock nut.

(b) Uncover the adjusting screw on the inside of the wheel and opposite the bleeder valve, by rotating the cover plate.

(c) Using a screw driver, turn the star wheel of the adjusting screw away from the axle until a brake drag is noticed when turning the wheel by hand. Back off the star wheel until there is no brake drag. Replace the cover plate.

4. <u>To service the wheels and tires</u>.

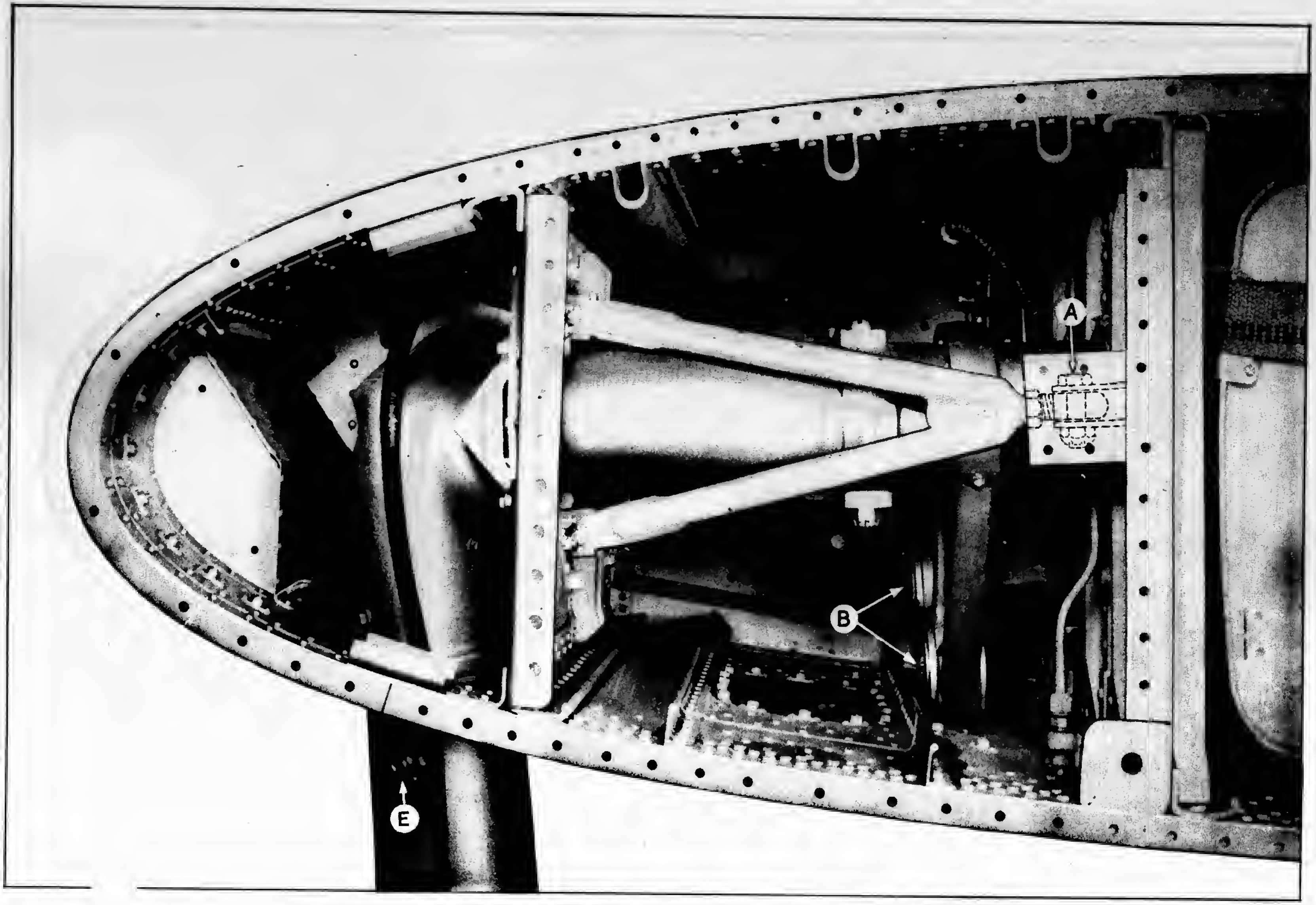
(a) Inspect the tires for wear, abrasions, bruises, etc.

(b) Tires should be inflated with consideration of the duty to be performed. Inflate so that the single circumferential ribs or deflection markers are at the ground line when the airplane is fully loaded. The pressure will vary for different loads and pressure information for tire inflation contained in this handbook should be used only as a guide.

(c) Check daily for proper tire inflation - 41 lbs. per sq. in. (2.8 kgs./cm^2.)

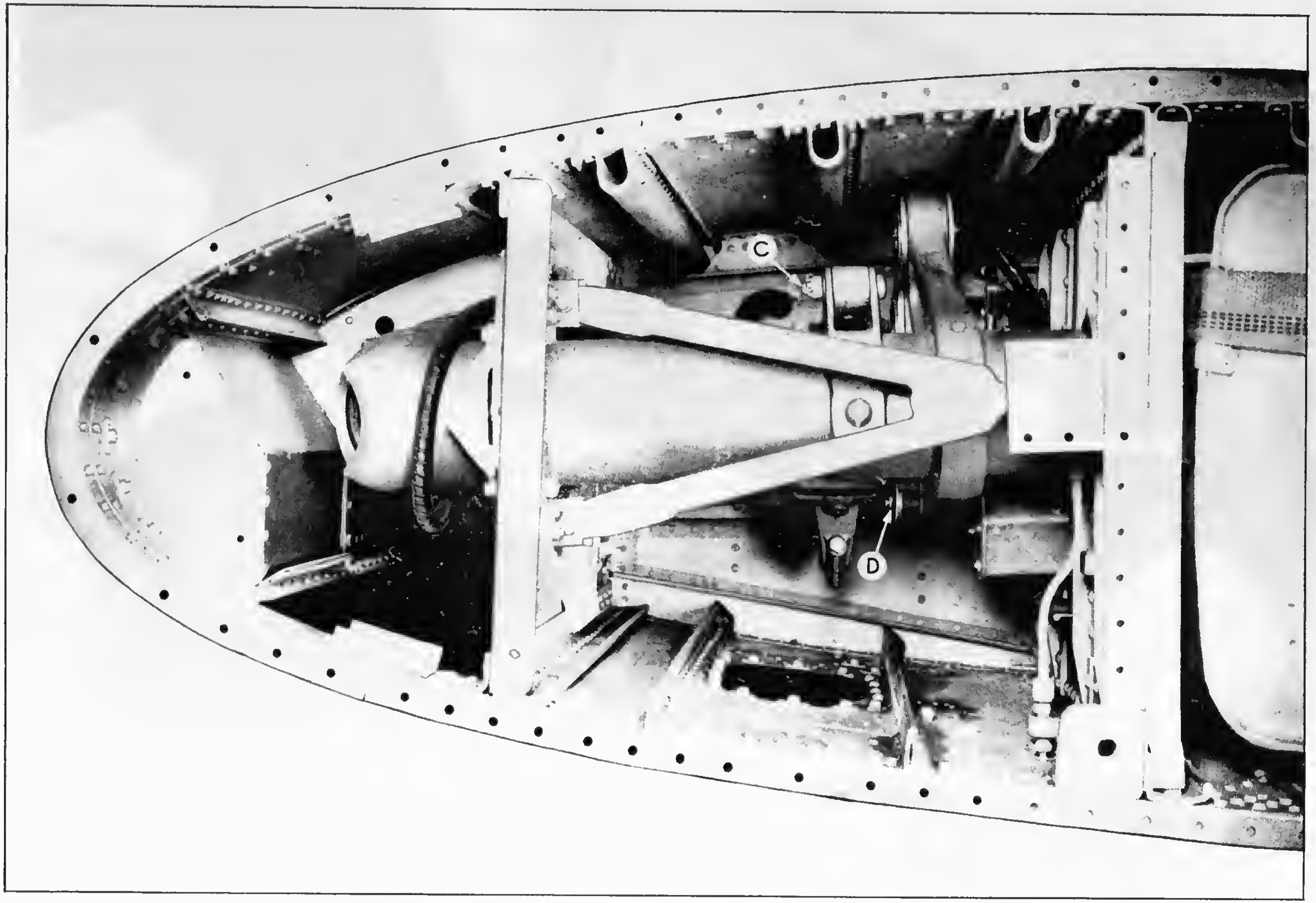
(d) Inspect the wheels for cracks and abrasions, check for looseness or binding in the bearings.

(e) See Section XXIII for additional maintenance information.



A. Brace Anchorage B. Retainer Bolts E. Valve Core Stem

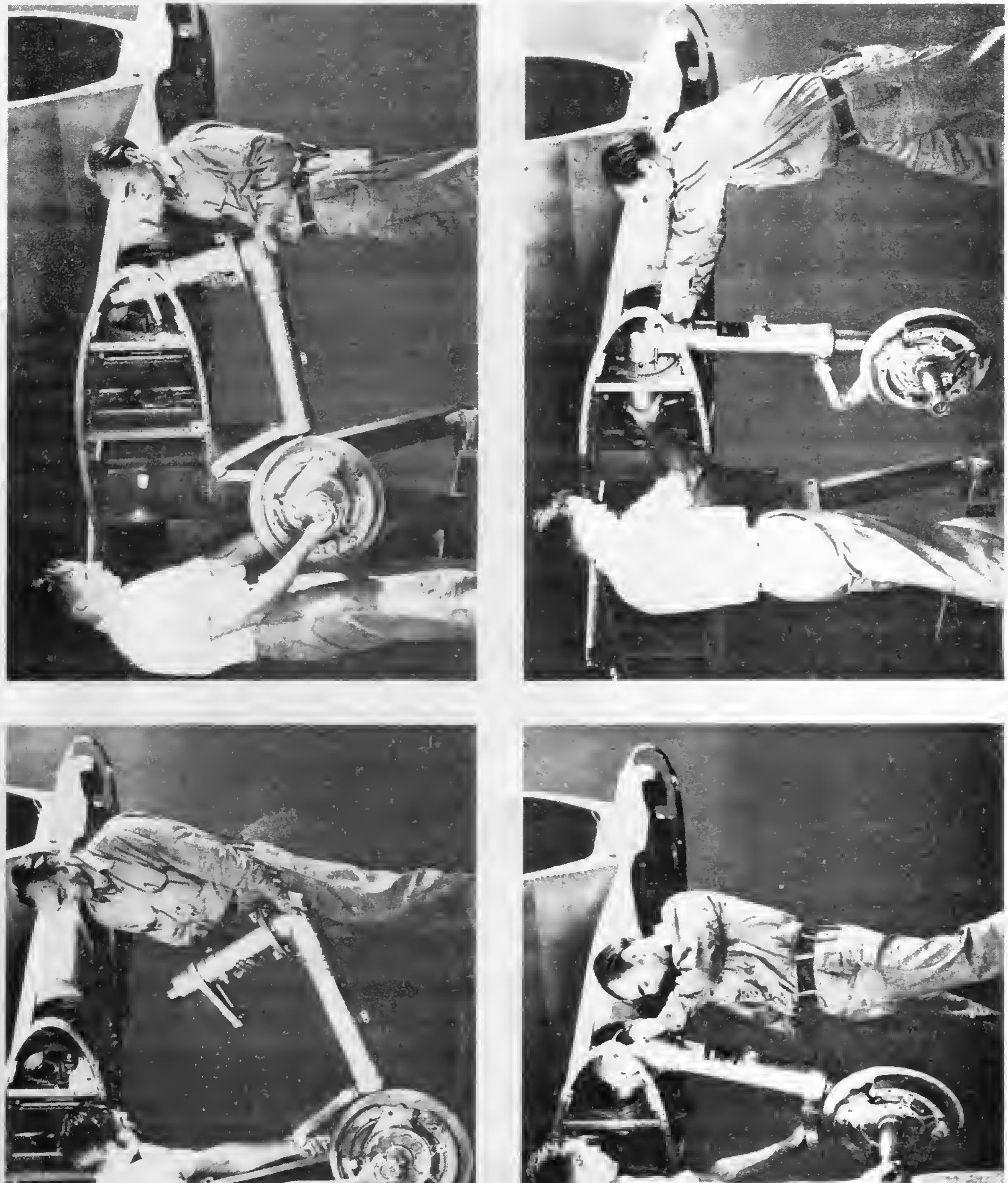
8135 - Landing Gear Mechanism Installation - Extended



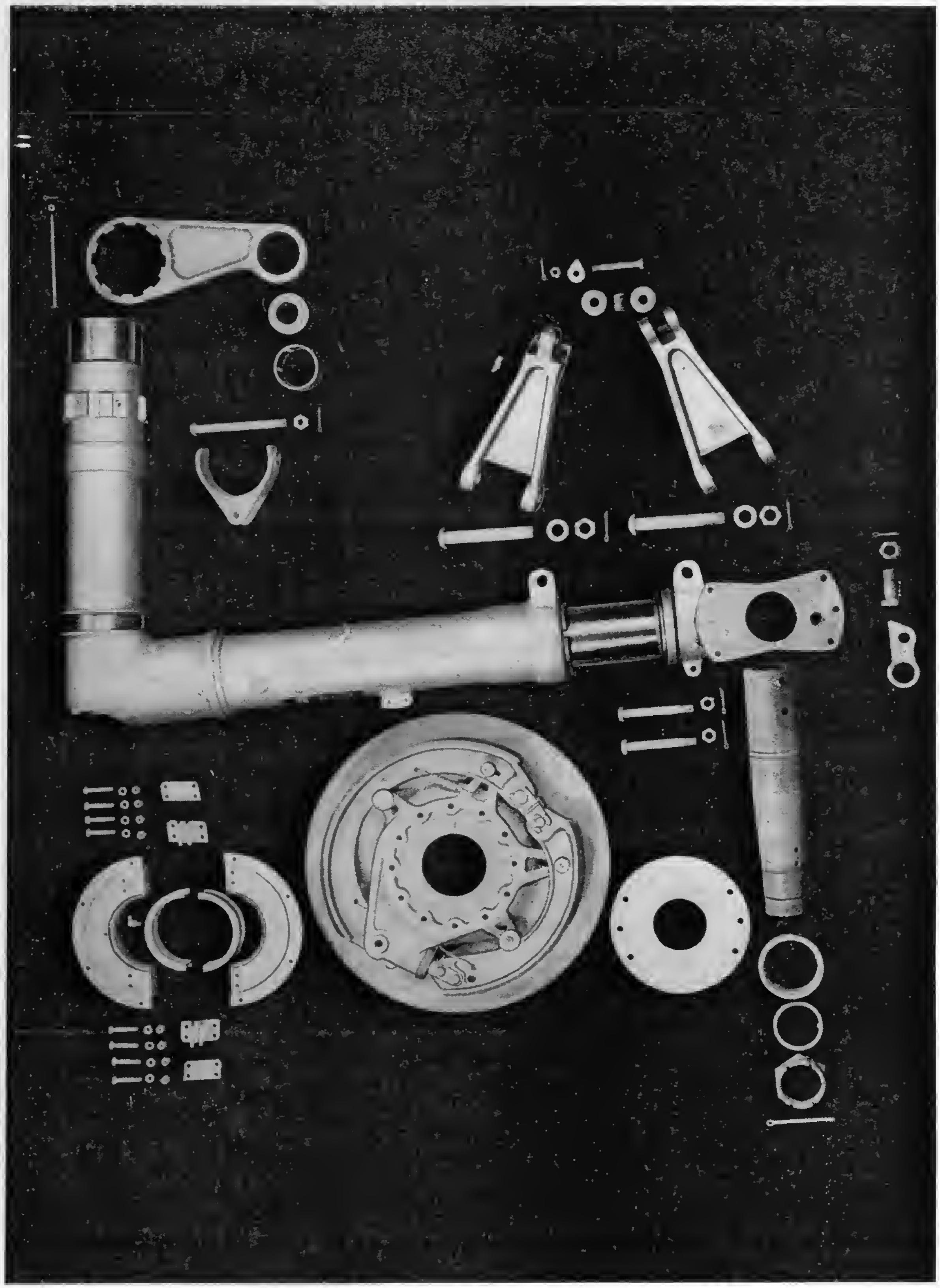
C. Piston Rod Anchor Bolt D. Jack Shaft Eccentric Assembly Bolt

8136 - Landing Gear Mechanism Installation - Retracted

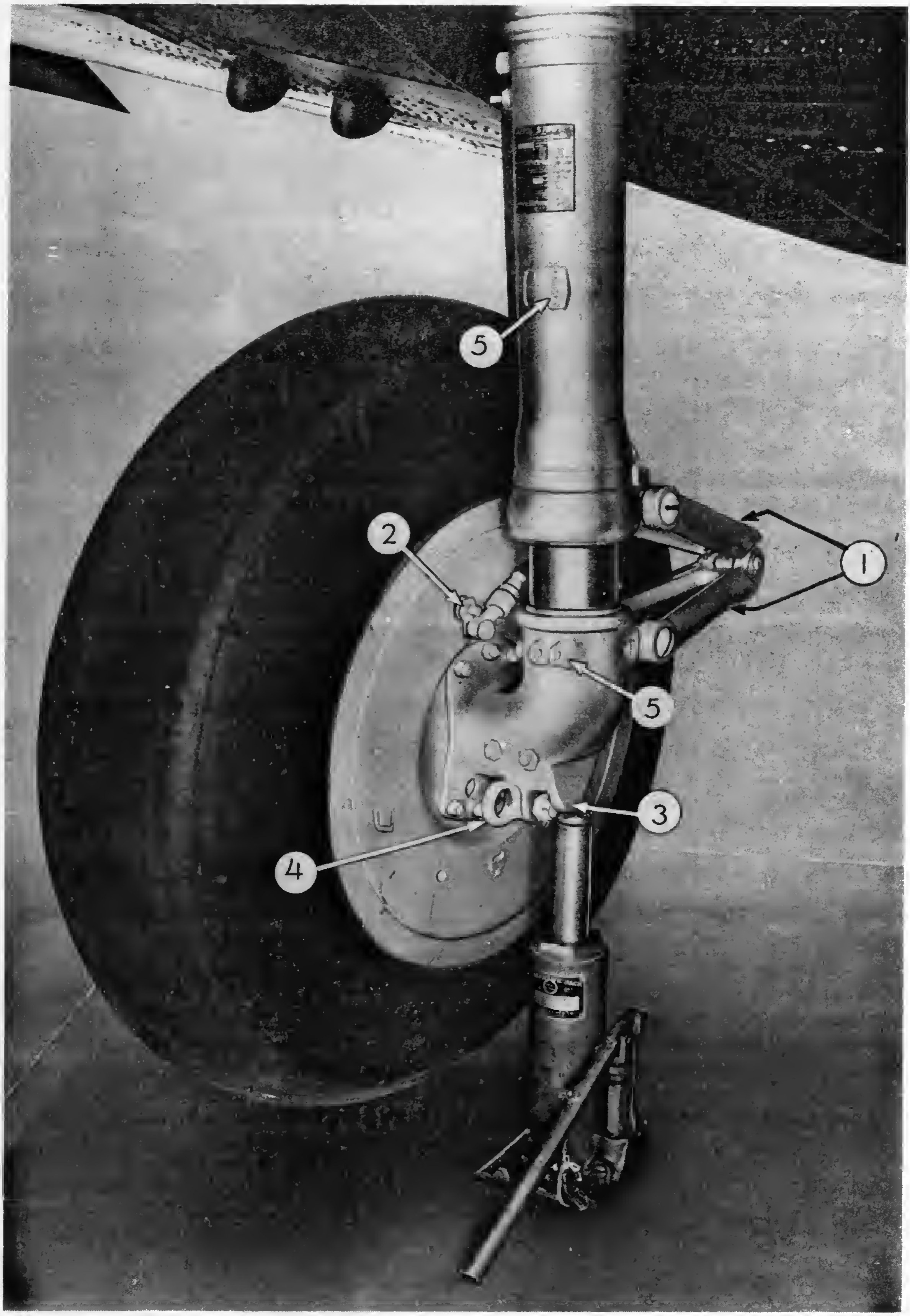
8240 - Landing Gear Extended



Method of Installing Landing Gear



2802 - Landing Gear Breakdown



1. Torsion Arms
2. Brake Bleeder Valve
3. Jack Pad
4. Towing Ring
5. Ski Attaching Brackets

5597 Landing Gear Wheel

SECTION XIII

HYDRAULIC SYSTEM

A. DESCRIPTION

1. General

(a) There are two separate hydraulic systems in this airplane. One is used to operate the landing wheel brakes. The second operates the landing gear retracting mechanism and the landing flaps. For identification of the fluid lines, see marking code, page XXV-6.

2. Brake System

(a) For description see page XII-1.

3. Landing Gear Retracting System

(a) A fluid reservoir is located on the right inside wall of the overturning structure. The filler cap is accessible from the outside.

(b) A Pesco 203AD hydraulic pump is located on the engine, driven by the right hand accessory drive shaft.

(c) A Bendix hand pump, Model 2232-B13, is located at the right side of the front cockpit for convenient operation by the pilot, should the engine pump become inoperative. A spring loaded relief valve located beside the hand pump set to hold 1200 $^{+50}_{-00}$ lbs. per sq.in. (84 $^{+3.5}_{-0.0}$ kgs/cm^2) takes care of overload conditions when hand pump is used.

(d) The automatic control valve assembly, (see page XIII-10) is mounted on the upper left side of the fuselage, just aft of the firewall and is connected to the engine pump by 1/2 inch (1.2 cm.) lines. It has connecting lines to the surge cylinder, the landing gear and the landing flaps mechanism. When the selector valves are in an operative position, the thrust rod forward, the automatic control valve operates with the surge cylinder, the landing gear and landing flaps mechanism and is actuated only by the fluid pressure furnished by the engine pump. It does not, however, operate when pressure is supplied to the system by the hand pump.

(1) A thrust rod (with a knob handle), located left of the flight instrument panel, is connected to the plunger of the control valve assembly. The forward movement of this thrust rod opens a port

allowing the hydraulic fluid (driven by the engine pump) to flow through the hydraulic system.

(2) A control valve (spring loaded), set to hold from 950 $^{+50}_{-00}$ lbs.per sq in. (67 $^{+3.5}_{-00}$ kgs/cm^2) governs the operating pressure and automatically by-passes the fluid flow when the gear or flap operations are completed, by returning the thrust rod aft or back to the "OFF" position. See B, page XIII - 10.

(3) A relief valve (spring loaded), set to hold from 1200 $^{+50}_{-00}$ lbs.per. sq.in. (84 $^{+3.5}_{-00}$ kgs/cm^2) relieves pressures above this amount and serves to by-pass the overload, in event the thrust rod should not fully return to the "OFF" position. See A, page XIII - 10.

(e) A surge cylinder, mounted on the aft side of the fire-wall is connected to the control valve by a 5/16 inch (.79 cm.) line. The purpose of this cylinder is to absorb momentary rises in pressure above 950 $^{+50}_{-00}$ lbs.per sq.in. (67 $^{+3.5}_{-00}$ kgs/cm^2) and thus prevent disengaging the control valve before the landing gear is completely retracted.

(f) A selector valve, attached to the forward side of web #2 in the left wheel well, directs the flow for extension or retraction of the landing gear. The lever at the side of the hand pump lever, which operates the retracting mechanism unlocking cams, also operates this valve.

(g) Hydraulically operated cylinders and pistons are used to rotate the torque shafts of the retraction mechanism. They are connected with flexible high pressure hose.

(h) Check valves in the pressure lines prevent flow through the engine pump or its by-pass when the hand pump is used.

(i) A pressure gage, calibrated in kgs/cm^2, is located beneath the engine instrument panel.

4. Landing Flap System

(a) A selector valve, located to the left of the pilot's seat, directs the flow for moving the flaps up or down. A neutral position is provided in order that the flaps may be held at any angle desired.

(b) An actuating cylinder, rigidly attached near the trailing edge of the wing center section, moves the flap control rods. See page XIII - 13.

(c) An indicator, mounted alongside and outboard of the bomb release selector and lock handles, shows the position of the flaps at all times.

B. DISASSEMBLY

1. Landing Flap Actuating Cylinder - See page XIII - 12

2. Landing Gear Actuating Cylinder - See page XIII - 11

3. Engine Pump Control Valve - See page XIII - 10

4. Landing Gear Selector Valve - See page XIII - 10

5. Landing Flap Selector Valve - See page XIII - 10

C. OPERATION

1. Brakes, see Section XII, B, 4.

2. Landing Gear, see Section XII, B.

3. Landing Flaps.

(a) To lower flaps; move the flap selector valve lever, located on the left side of the pilot's cockpit, to the "DOWN" position, then push forward on the thrust rod knob, located left of the flight instrument panel. Hold the knob forward for from two to five seconds. When the flaps are lowered the thrust rod will automatically return to its aft position.

(b) To raise flaps; move the flap selector valve lever, located on the left side of the pilot's cockpit, to the "UP" position, then push forward on the thrust rod knob located left of the flight instrument panel. Hold the knob forward for from two to five seconds. When the flaps are raised the thrust rod will automatically return to its aft position.

NOTE: In case of an emergency when the flaps are in the "DOWN" position and it is desireable to flatten, or lengthen the glide quickly, simply place the selector valve lever in the "UP" position, allowing the force of the air stream to close the flaps. They will close to approximately 15 degrees.

(c) To raise or lower flaps with the engine pump inoperative; move the selector valve lever to the desired position and operate the hand pump. Make sure the thrust rod knob is in its complete aft position.

D. TO ADJUST THE VARIOUS VALVES OF THE HYDRAULIC SYSTEM

NOTE: The valves referred to in this paragraph are carefully adjusted and checked at the factory, and should need no further attention. If, however, adjustments are required, it is recommended that the part or parts be removed from the airplane, and the adjustments made with the use of a motor driven bench pump and gage. Should this not be possible, and adjustments are required, proceed in the following manner.

CAUTION: It is definitely recommended that a spreader bar be inserted and in place between the landing gear struts before starting, and kept there while adjustments are being made on the hydraulic system. This protects against accidental retraction of landing gear and subsequent drop of the airplane.

1 Fill the fluid reservoir, located on the upper right side of the overturning structure, with Lockheed No. 5, Hydraulic Fluid. This must be done while the landing gear is "DOWN" and the landing flaps "UP" to avoid subsequent overflow.

2. Have the landing gear completely "DOWN". It is advisable to fasten the latch control lever securely in the "DOWN" position, before and while adjustments are being made.

3. Back off the locknut and screw the valve down until inoperative on each of the following:

   (a) The working pressure valve of the automatic control valve assembly (see (A), page XIII - 10). This valve is the lower adjustment of the two on the forward end of the valve assembly as installed in the airplane.

   (b) Hand pump relief valve, spring loaded.

   (c) Landing flap relief valve, (see (C), page XIII - 10).

4. With the engine pump in operation, press and hold forward the thrust rod until the emergency relief valve permits the hydraulic fluid to by-pass. When the dial reading on the pressure gage remains constant, it signifies that the fluid is by-passing. Note the reading on the pressure gage, located beneath the engine instrument panel. This reading should be 1200 $^{+50}_{-00}$ lbs per sq.in. (84 $^{+3.5}_{-.00}$ kgs/cm^2). This valve is the upper adjustment of the two on the forward end of the valve assembly as installed in the airplane. If adjustment is needed, screw valve in or out as required. When properly set, screw locknut down securing the emergency relief valve.

<u>NOTE</u>: This adjustment should only be made when the landing flap selector valve lever is in the "NEUTRAL" position and the landing gear latch control lever in the "DOWN" position.

5. To adjust the spring loaded <u>working pressure control valve</u> (see Ⓑ , page XIII - 10) of <u>the automatic control valve assembly</u>, place the landing gear selector valve handle in "DOWN" and the thrust rod in its complete aft position. Place the landing flap selector valve lever in the opposite position. If flaps are up, place lever in down position and vice versa. The working pressure valve adjustment is the lower adjustment of the two on the forward end of the valve assembly as installed in the airplane. With the engine pump in operation press the thrust rod forward, permitting the fluid to be forced through the hydraulic system. Hold the thrust rod forward for from two to five seconds. The fluid will pass through the automatic control assembly and operate the landing flaps. When the operation is completed and the flaps are completely up or down, the control valve (see page XIII - 10) set to release at a pressure of 950^{+50}_{-00} lbs.per. sq.in. ($67^{+3.5}_{-00}$ kgs/cm^2) permits the fluid pressure to move the thrust rod to its complete aft position (the "OFF" position).

   (a) At this time note the reading on the pressure gage to determine if the control valve has the proper setting.

   (b) If adjustment is required, back off the locknut on the working pressure control valve and screw the valve in or out as the case requires. When adjustment is complete, screw down the locknut, securing the valve.

6. <u>Landing Flap Relief Valve</u> (see Ⓒ , page XIII - 10).

   With the hand pump relief valve made inoperative, as outlined in paragraph 3, proceed as follows: With the thrust rod in its aft position, landing flap selector valve lever in the "UP" position, back off locknut and screw of spring loaded relief valve and operate the hand pump lever and note the pressure gage reading at the time of by-passing of hydraulic fluid. This should read 1200 $^{+50}_{-00}$ lbs. per sq.in. ($84^{+3.5}_{-00}$ kgs/cm^2). If adjustment is required, screw the valve in or out as needed. When relief valve by-passes the fluid at the proper pressure, screw down the locknut securing the valve and return the selector valve lever to the "NEUTRAL" position.

7. To adjust the <u>hand pump</u> (<u>spring loaded</u>) <u>relief valve</u>, place the landing gear latch control lever in its "DOWN" position, the landing flap selector valve lever in "NEUTRAL" and the thrust rod in its complete aft position. Back off locknut and screw of spring loaded relief valve.

Operate the hand pump lever and note the pressure gage at what reading the fluid is by-passed. This reading should be 1200^{+50}_{-00} lbs.per sq.in. ($84^{+3.5}_{-0.0}$ kgs/cm^2). If adjustment is needed, screw the valve in or out as the case requires. When the fluid by-passes at the proper pressure, screw down the locknut, securing the valve.

E. MAINTENANCE

1. To Bleed the Brake Hydraulic System

(a) Fill the fluid reservoir, located on the upper right front side of the firewall, with Lockheed No. 5 hydraulic fluid.

(b) Open the bleeder valves on the wheel brake cylinders by removing the small screws in the ends of the bleeder fittings, screwing in the bleeder extension lines, and then loosening the hex nuts.

(c) Pump the brake pedals SLOWLY until fluid free from air bubbles flows out of the extension lines. The reservoir MUST NOT be allowed to become empty during this operation. The open end of the bleeder extension should be submerged in fluid to prevent the suction of air into the lines while pumping the pedals.

(d) Close the bleeder valve and test the brakes. Excessive "softness" should not be evident; if so, the lines still contain air and additional bleeding is necessary.

(e) When a new master brake cylinder installation is required, it may be necessary to bleed the cylinder. To do this, remove the hex nut plug on the top side of the cylinder then slowly depress the pedal once. This operation will force out the trapped air and some of the fluid. Be sure to replace the plug before relieving pressure on pedal. After hex nut bolt has been secured, the pedal may be allowed to return to its normal position.

2. To Bleed Landing Gear and Flap Systems

(a) To bleed the engine pump, hand pump, landing flaps and landing gear systems, it will be necessary to make sure that the fluid reservoir is full. (See D, 1, this section.) The airplane is to rest on the ground in its normal three point position, with the engine and engine hydraulic pump in operation and the horn warning switch to "OFF" (horn warning switch should be off so that the blare of the horn will not be disconcerting to the operator.)

(1) Secure the landing gear latch control lever in the "DOWN" position.

(2) Move the landing flap selector valve lever from the "UP" to the "DOWN" position, using the engine pump for pressure. Continue until a smooth, steady operation is observed. Four to five complete operations should suffice.

(3) Stop the engine and support the airplane on two stands, each stand being placed under the wing center section. The stands should be well padded so that the surface of the stands will not rub against the surface of, and thus injure the wing skin. These stands should be of sufficient height so that the landing wheels are free to retract.

(4) With the landing flap selector valve lever in the "NEUTRAL" position, operate the hand pump, at the same time move the landing gear latch control lever from "DOWN" to "UP", thus raising and lowering the landing gear. Continue this operation until a smooth, steady operation is observed Four or five times should suffice.

(5) With the landing gear fully extended, operate the hand pump and move the landing flap selector valve lever from "UP" to "DOWN" until a smooth, steady operation is observed. Four or five times should suffice.

(6) These tests should be repeated until all erratic, jerky, or spasmodic action disappears and smooth performance is established.

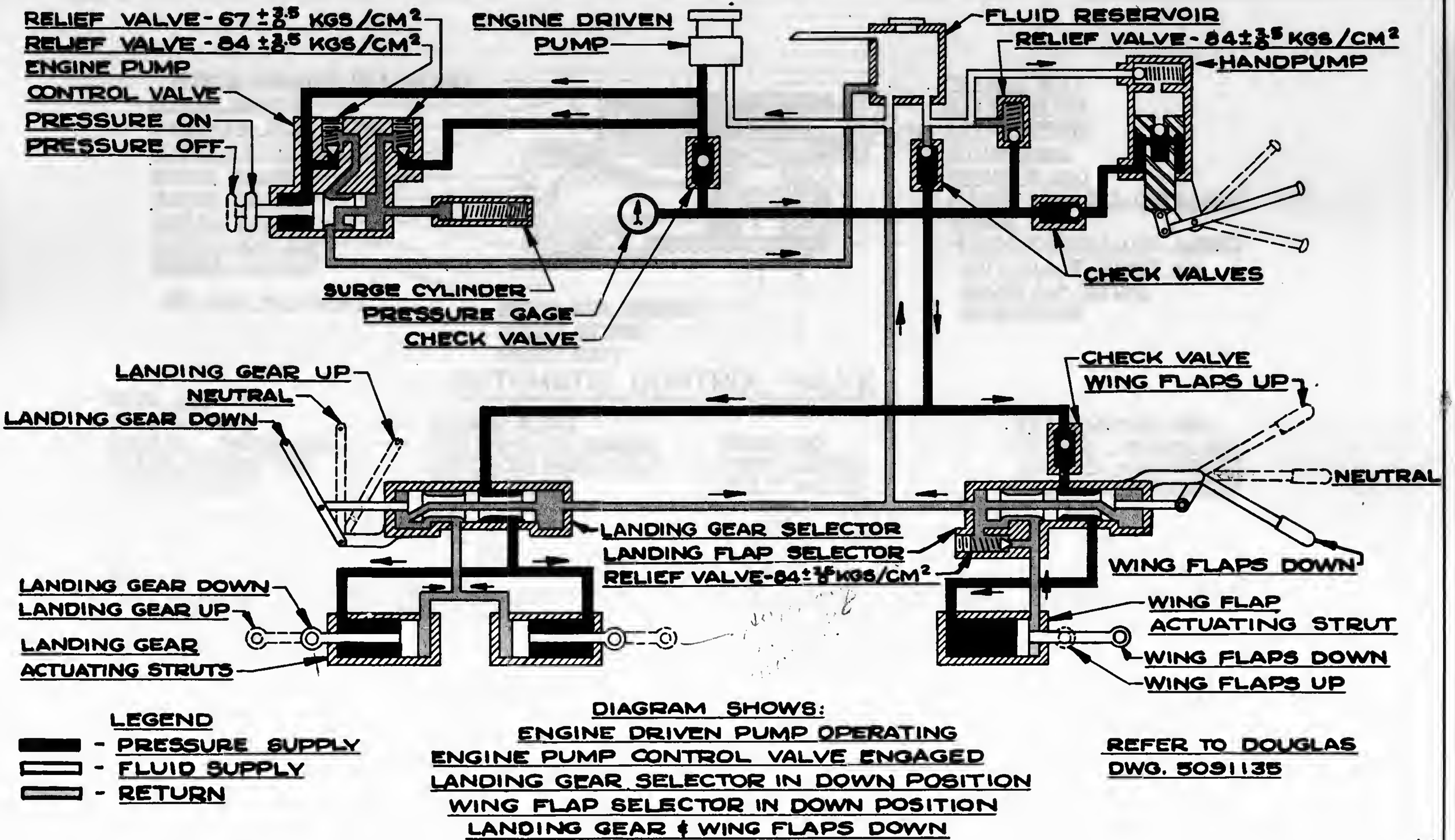
(7) <u>At the completion of these tests make sure the landing gear is fully extended and locked</u> and the horn warning device switch returned to its operative position.

NOTE: There is no special bleeding arrangement on landing gear or flap cylinders because repeated operation of these systems, as outlined above, forces air up to the fluid reservoir from which it escapes through the vent line.

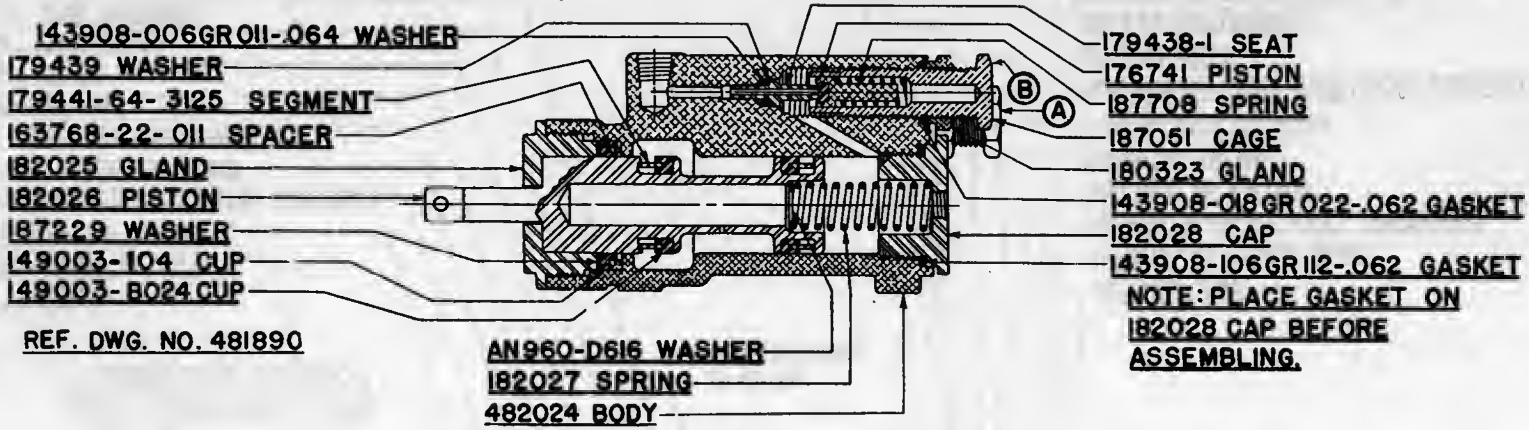
3. For additional maintenance information, see SECTION XXIII.

NOTE: For relief and control valve settings, to be used on all 8A-5 airplanes, see table below.

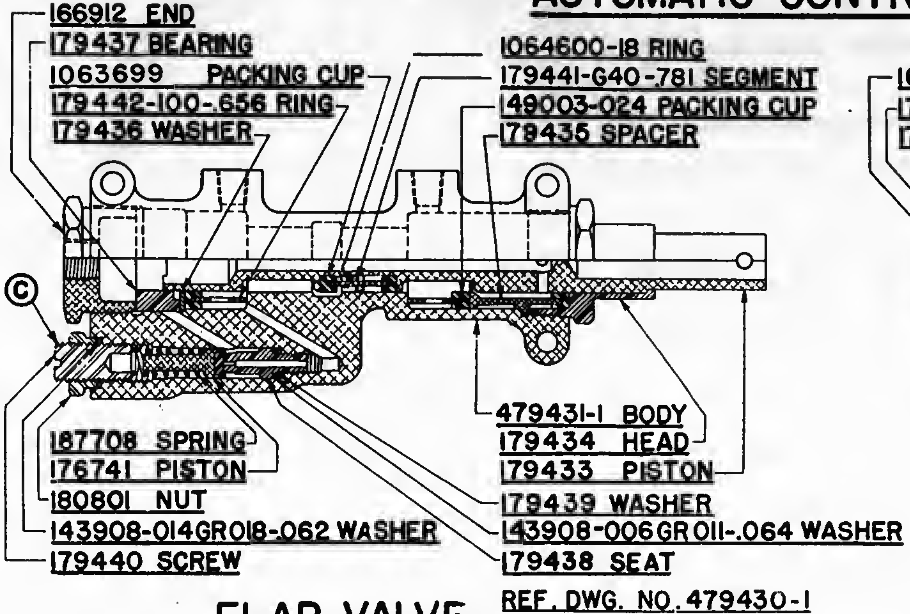
	SET RELIEF VALVES TO HOLD
Automatic Control Relief Valve	1200 $^{+50}_{-00}$ lbs/sq.in. 84 $^{+3.5}_{-00}$ kgs/cm^2
Automatic Control Valve	950 $^{+50}_{-00}$ lbs/sq.in. 67 $^{+3.5}_{-00}$ kgs/cm^2
Flap Selector Valve Relief Valve	1200 $^{+50}_{-00}$ lbs/sq.in. 84 $^{+3.5}_{-00}$ kgs/cm^2
Hand Pump Relief Valve	1200 $^{+50}_{-00}$ lbs/sq.in. 84 $^{+3.5}_{-00}$ kgs/cm^2



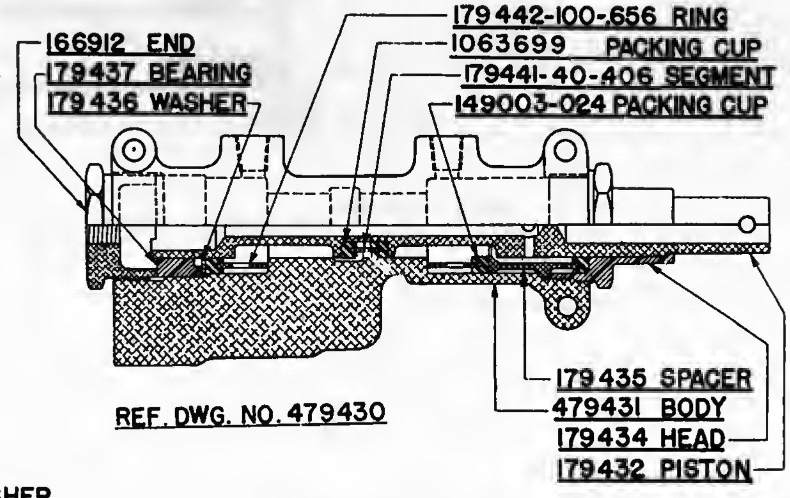
HYDRAULIC SYSTEM



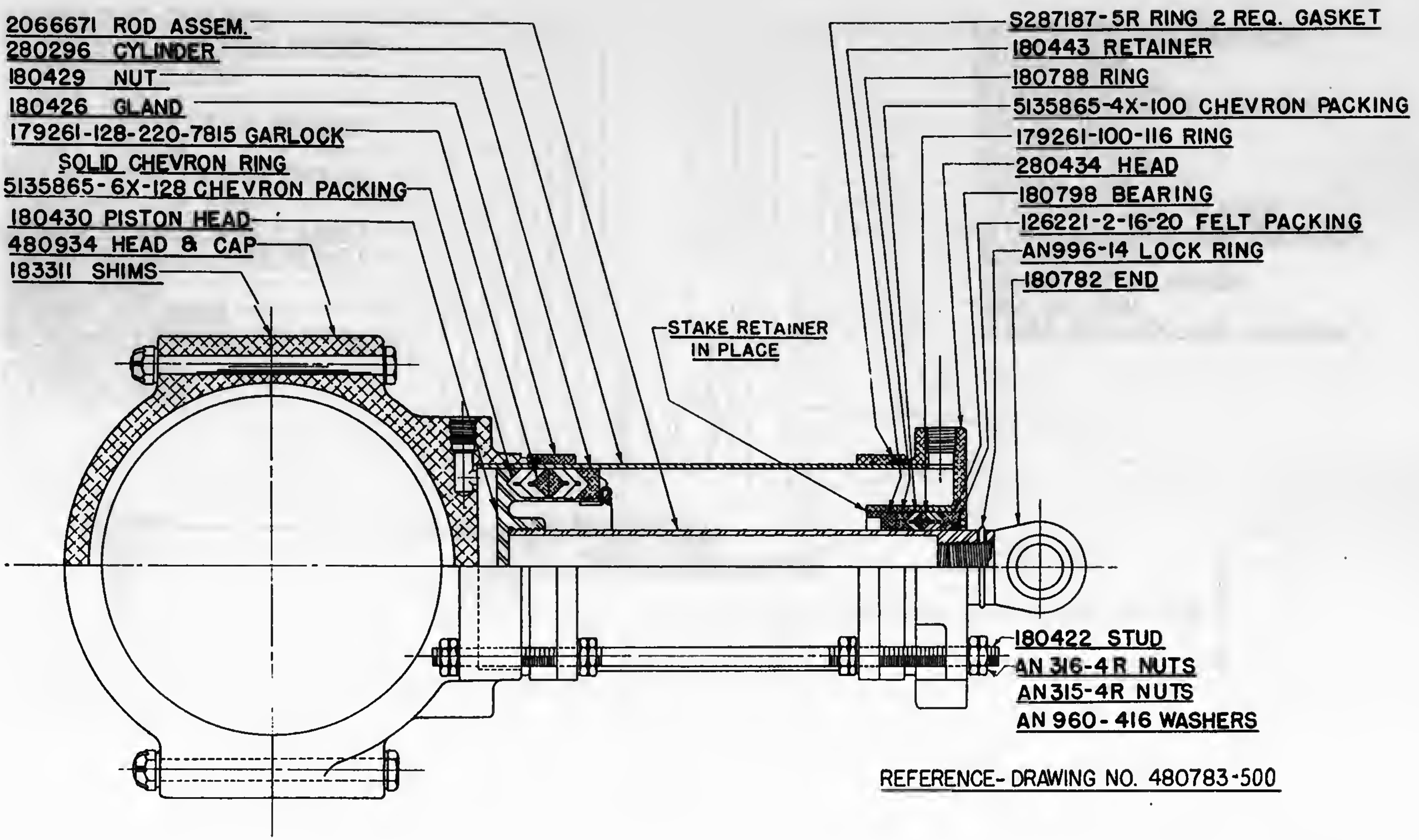
AUTOMATIC CONTROL VALVE



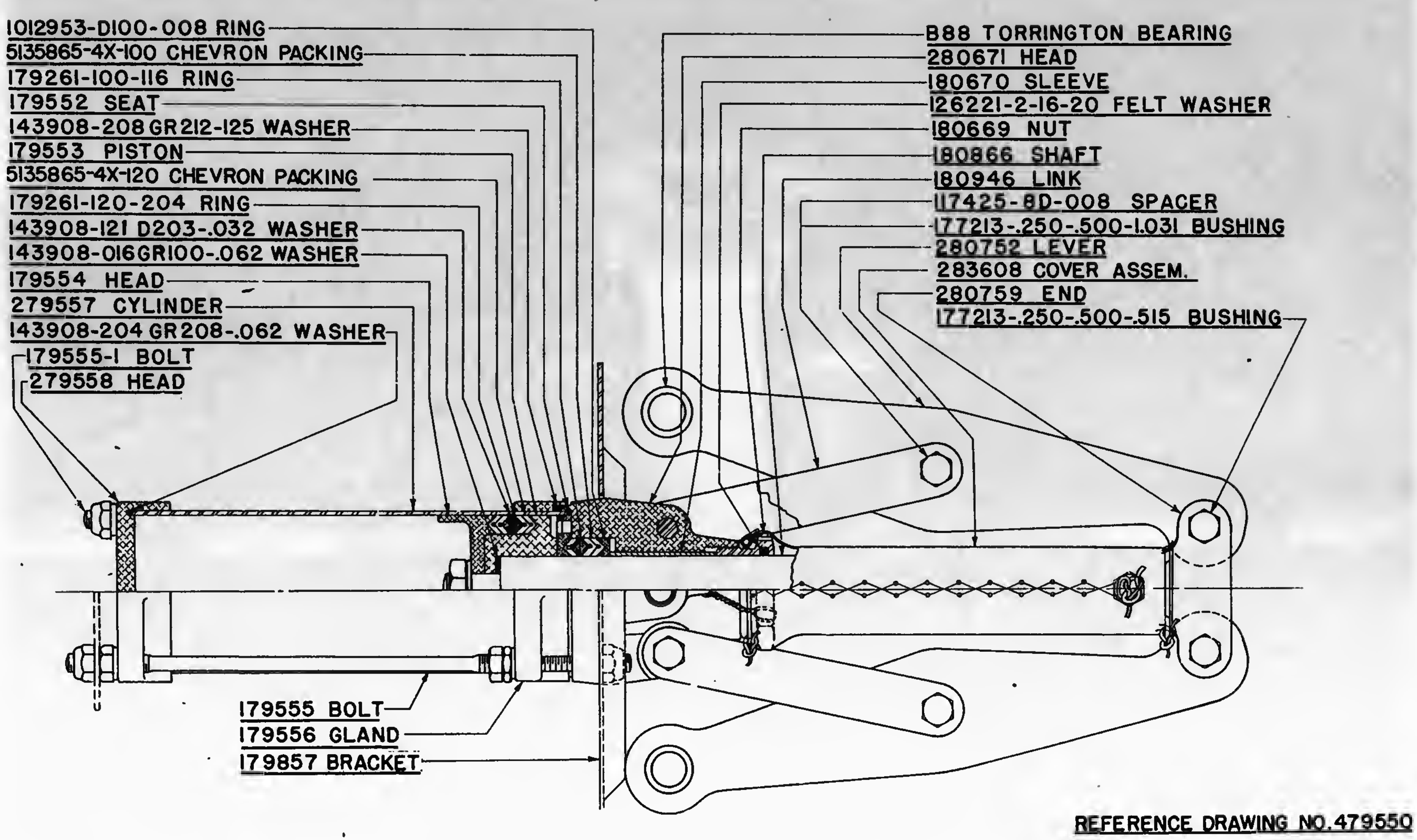
FLAP VALVE



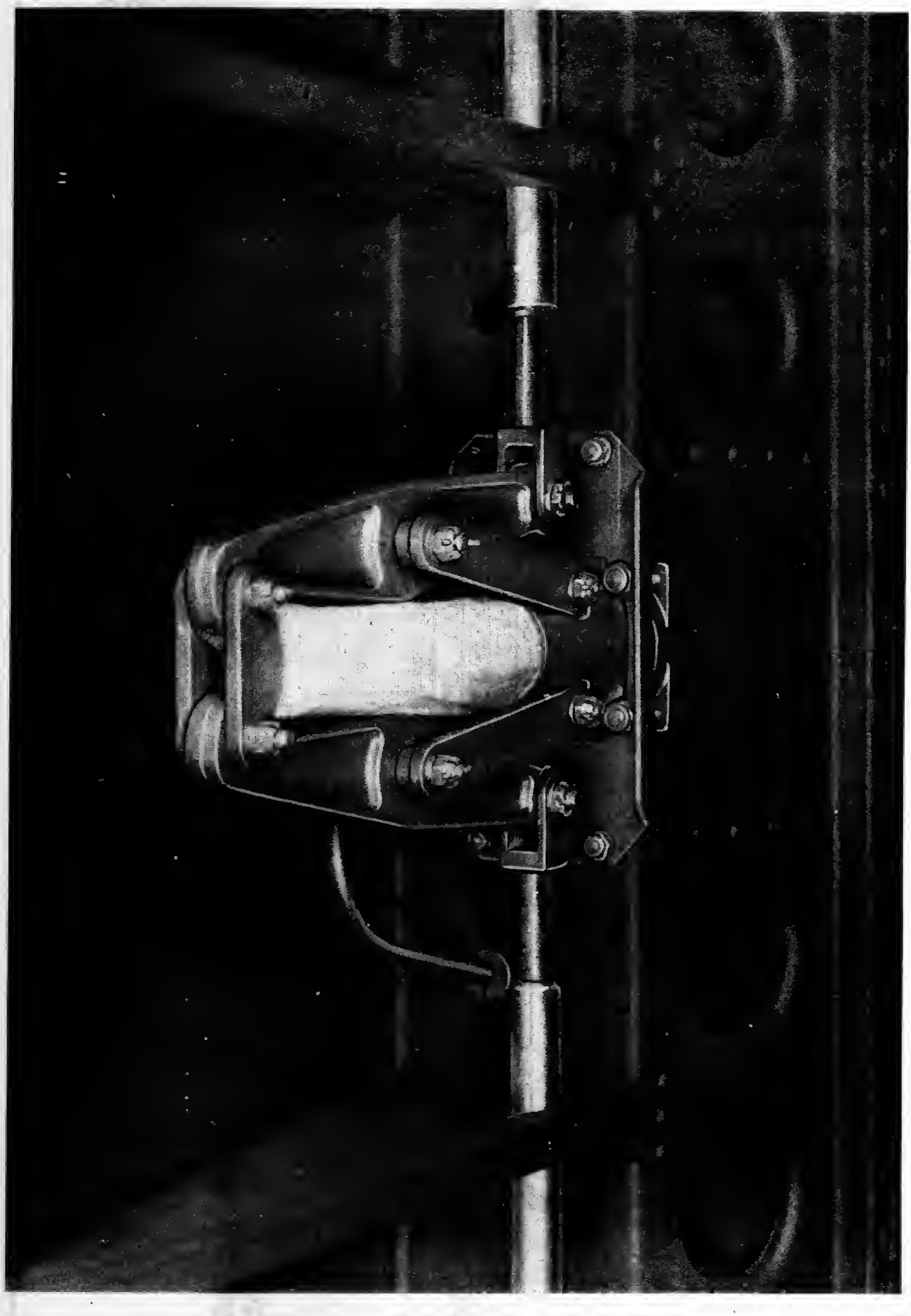
LANDING GEAR VALVE



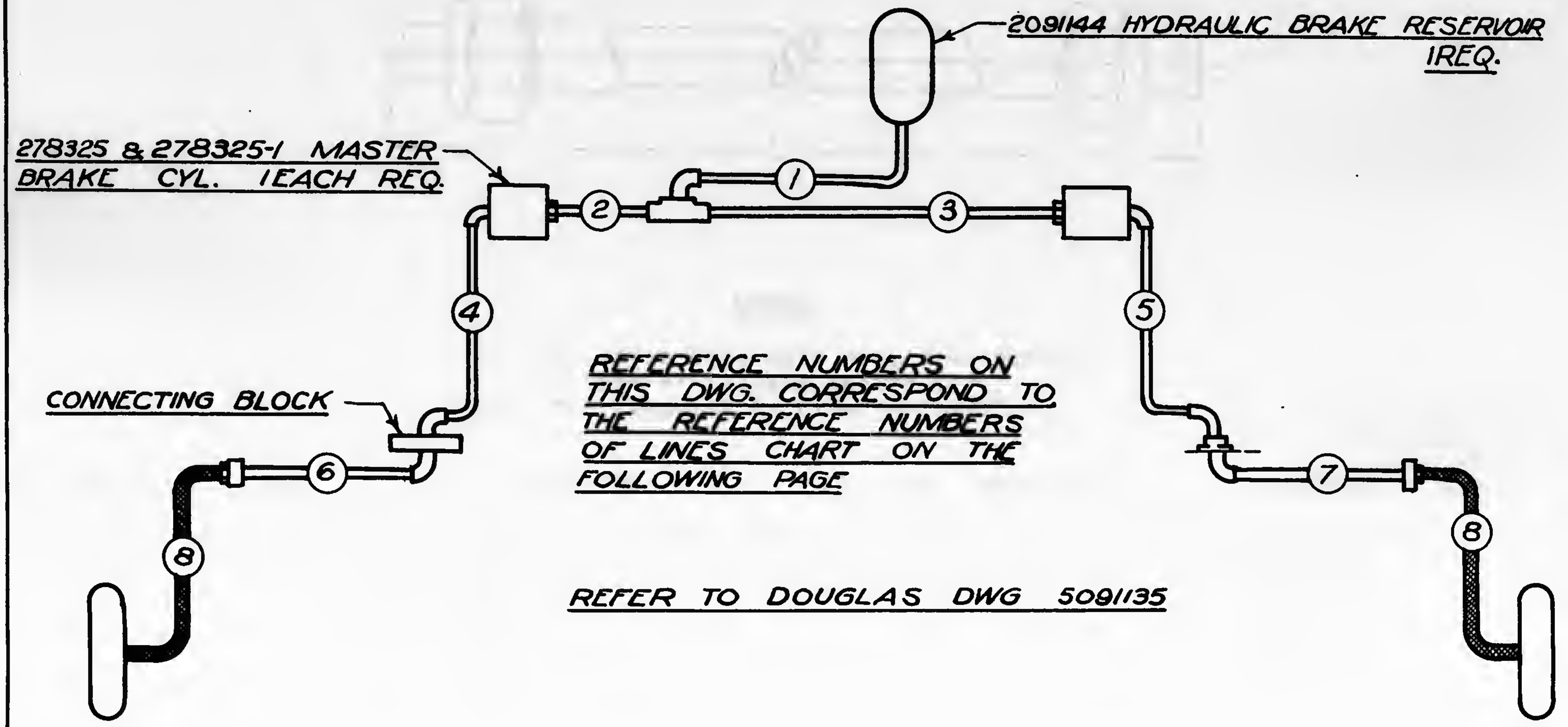
LANDING GEAR ACTUATING CYLINDER



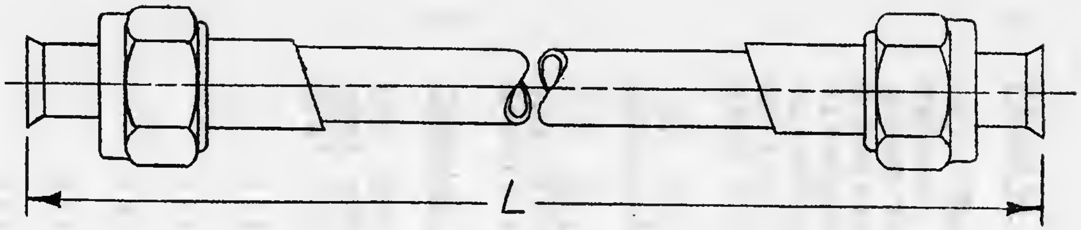
LANDING FLAPS ACTUATING CYLINDER



5693 - Landing Flaps Actuating Cylinder



HYDRAULIC BRAKE SYSTEM



NOTES

1. All lines have ends worked according to type of fitting called for.
2. Color banding is blue-yellow-blue.

REF.	PART NO.	REQ.	LOCATION	DIA.	GAGE	MAT.	L.	FITTINGS	REQ.
1	5091135-14	1	Fluid Reservoir to 163041 Flange	5/16	.032	52SO	23½	AC811BT5 AC811T5CS	2 2
2	5091135-16	1	L.H., 163041 Flange to L.H. Master Brake Cylinder.	5/16	.032	52SO	26	AC811BT5 AC811T5CS	2 2
3	5091135-15	1	R.H., 163041 Flange to R.H. Master Brake Cylinder.	5/16	.032	52SO	26½	AC811BT5 AC811T5CS	2 2
4	5091135-57	1	L.H., 180136 Fitting to L.H.Master Brake Cylinder.	5/16	.032	52SO	6	AC810B5	2
5	5091135-58	1	L.H., 53041 Flange to L.H. Master Brake Cylinder.	5/16	.032	52SO	9	AC811BT5 AC811T5CS AC811B5	1 1 1
6	5091135-12	1	L.H., 180136 Fitting to Flexible Hose.	5/16	.032	52SO	28	AC811BT5 AC811T5CS	2 2
7	5091135-11	1	R.H., 163041 Flange to Flexible Hose.	5/16.	.032	52SO	40	AC811BT5 AC811T5CS	2 2
8	Bendix 122-S-555	2	L.H. & R.H. Rigid Line to Wheel					Bendix-50421	2

BRAKE SYSTEM LINES CHART

SECTION XIV

FUSELAGE EQUIPMENT

A. DESCRIPTION

FRONT COCKPIT

1. Pilot's Seat

(a) The standard vertically adjustable pilot's seat is made of sheet aluminum and is supported on two vertical tubes which are drilled to receive the seat locking pins. A release handle, located on the right side of the seat, disengages the locking pin and allows the seat to be raised by an elastic shock cord or lowered by the weight of the pilot, as desired. A Type B-10 safety belt, adjustable at the side, is fitted to the seat.

(b) The pilot's seat will permit the use of a seat type parachute.

(c) A life preserver cushion is attached to the back of the pilot's seat by means of two hooks, and is removed by merely lifting the cushion from the hooks.

2. Control Pedestal

(a) The control pedestal is mounted forward of the pilot's seat and between the rudder pedals. The following equipment and controls are mounted thereon:

(1) Vacuum pump and venturi control handle.

(2) Parking brake locking handle.

(3) Carburetor heat control handle.

(4) Cockpit heat control handle.

(5) Fuel tank selector valve control handles.

3. Surface Control Locks

(a) A pair of locks is provided for use on the front control stick and rudder pedals when the airplane is parked. This lock is stowed on the front of frame #4½ aft of the pilot's seat.

4. Map Case

(a) A map case is located forward of the pilot's seat and above the control pedestal. In each airplane the map case contains: 1 each; Master Wiring Diagram, Fuel Diagram, Oil Diagram, Pilot's check-off list.

5. Oxygen Equipment (Drawing #5091556)

(a) Oxygen mask, bag, regulator, flow gage and manifold pressure gage are mounted on right side of cockpit aft of frame #4.

(b) The oxygen cylinder is mounted horizontally and transversely aft of frame #6. The cylinder contains 48.3 cu. ft. (1368 liters) of oxygen which is under pressure of 1800 lbs. per sq. in. (126 kgs/cm^2).

(c) Operation and flow is accomplished by turning the regulator in a clockwise direction which opens the valve permitting the oxygen to flow to the mask

(d) For complete instructions for installation, maintenance and use see Instructions, Puritan Compressed Gas Corporation.

6. Radio

(a) Radio controls are mounted on right side of cockpit between frames #3 and #4. Detailed description will be found in Section XXI, Electrical Installation.

7. Interphone

(a) Voice communication between pilot and gunner is accomplished by use of the radio equipment. See Section XXI for description and operation.

8. Fire Extinguisher (Drawing #5091519 and 5091520)

(a) A "Lux" CO_2 Fire Extinguisher System, which ejects the gas through perforated tubing about the aft section of the engine and through a nozzle directed about the carburetor, is installed in the airplane. In general, the system consists of a supply of CO_2 gas stored in a specially machined lightweight steel cylinder which is fitted with a quick-release valve; a tubing system and carburetor nozzle for conducting and distributing the gas; and a control handle for the manual operation of the system.

(b) The supply cylinder is attached to a support assembly above and aft of pilot's seat, forward of frame #5. The cylinder is stowed transversely on its support assembly.

(c) Tubing system is identified by the 1/2 inch (1.25 cm.) bands of red paint near each end and at such intermediate points as are necessary to conveniently trace tubing.

(d) Release handle is located just aft and left of the pilot's seat. It is painted red and nameplate reads "Fire-Pull".

(e) Operation: Pull red painted handle referred to, straight out. A 2 inch (5 cm.) pull is required to rotate the two levers which sets the cam, torque arm and lead screw in action allowing the CO_2 to flow.

(f) Inspection: As part of pre-flight inspection, observe inspection window - if cross on indicator is visible, cylinder is empty and cylinder should be recharged before airplane is permitted to fly.

(g) Testing: It is recommended that the system be tested once every four months.

(h) For complete instruction for installation, operation and maintenance see Instruction Book, Walter Kidde & Co., Inc.

REAR COCKPIT

9. Gunner's Seat

(a) Construction: A rotating seat, with its supporting structure, which can be raised, lowered, and swung vertically and horizontally, comprises the seat used by the gunner. The seat is made of aluminum alloy sheet and is supported on two steel tubes hinged near their upper ends. The seat support tubes are mounted on a carriage which tracks on the seat ring. The seat ring is mounted on two bearings, one on each side of the fuselage, to permit the seat to be tilted. Two sectors, integral with the seat ring, are located on each side and are drilled to receive the locking pins. A continuous length of shock cord, supported by pulleys on each side of the mount, maintains a steady upward tension on the seat.

(b) Operation: The seat release handle, located on the bottom of the seat, when released permits the seat to be raised or lowered. It may be unlocked for tilting either fore or aft by exerting foot pressure on operating pedal, located to the rear of the gunner's seat and on the left side of the fuselage. (When facing aft the right foot operates this pedal.) The two steel seat support tubes are hinged near their upper ends so that the seat may be swung forward 82° up against the ring and locked clear of the gunner, when the bomber's compartment is to be used.

NOTE: Before the seat can be tilted it must be completely down and locked facing aft in order to clear all equipment.

With the seat locked in this position, the gunner has freedom of action in which to use the view finder and camera, while seated on the center section trailing edge with the bomber's compartment lowered. Attached to the seat ring is an arc of track along which the gun truck operates. A hinged adapter is supplied with the airplane and connects the gun to its truck. The available field of the gun fire extends throughout the entire rear quarter sphere except that small area blanketed by the vertical tail surfaces. The horizontal fire arc extends 25° forward on either side and the depressed arc covers 62° either side of the fuselage.

(c) Fittings: A Type B-10 Safety Belt, adjustable at the sides, is fitted to the seat.

10. Engine Controls

(a) Throttle and Mixture Control levers are located in their quadrant on left side of cockpit. The push rods are connected to and operate with the push rods from the engine control levers in the front cockpit.

(b) Supercharger controls are located in the front cockpit only, therefore, changes from low to high blower cannot be made from rear cockpit.

(c) Ignition Switch. A remote control of the ignition switch is located on the engine controls panel. By turning the switch handle, the switch in the front cockpit is moved to the "ON" or "OFF" position. This is accomplished by a tubing connection from the ignition switch in the front cockpit to the switch handle in the rear cockpit. Directional changes of the tubing is made possible by the use of universal joints.

11. Life Preserver Cushion

(a) A life preserver cushion is supplied for use of the gunner. It is designed for use on the gunner's seat and can quickly be picked up from the seat in case of an emergency.

12. Gun Tunnel

(a) Two spring loaded doors, located aft of the rear cockpit, forming part of the upper skin of the fuselage, enclose the gun tunnel which serves as a stowage compartment for the flexible gun. The doors are actuated, through a flexible cable and pulley system, by a foot pedal located aft of the gunner's seat and on the right side of the fuselage, when facing aft, the left foot operates this pedal. A rubber socket and a positive latch secure the gun where it is stowed.

13. Bomber's Compartment

(a) A retractable bomber's compartment is hinged to the lower fuselage framework just aft of the center section trailing edge and is accessible from the gunner's cockpit. Extension and retraction is accomplished by a drum and cable hoist with a worm and pinion drive. The mechanism is operated by a crank on the left side of the rear cockpit at frame #9.

(b) Provision is made for the mounting of a Fairchild K-3C camera and view finder or an Estoppey Type D-4B bomb sight, over the flexible shutter in the bottom of the compartment. The removable floor, used to cover the opening, is lifted out after releasing the 4 attaching screws, thus permitting the camera or bomb sight mount to be installed. The flexible metal shutter is operated by pull cables and when closed, covers the circular opening in the bottom of the compartment. The electric control and the pilot and camera junction box are located on the right side of cockpit at frame #9.

(c) A window of shatter-proof glass is set in the forward wall of the compartment. A removable corrugated metal cover protects this window when not in use and can be readily extracted and replaced. A hinged door which opens in, installed on the forward right side of the compartment, permits cleaning the outer surface of the window in the forward wall, while in flight.

(d) Four small windows of transparent sheet are set in the fuselage skin on each side of the airplane just above the bomber's compartment between frames #9 and #11.

(e) The internal bomb release system has a release unit operable from the bomber's compartment as well as one in the pilot's cockpit.

14. Engine Crank

(a) Stowage is provided in a bracket and clip arrangement left side of cockpit between frames #7 and #8 near cockpit floor.

15. Control Stick, Rear

(a) Stick is stowed in a socket and strap attaching device, left side of cockpit between frames #7 and #8 just above Engine Crank.

(b) Strap may be quickly detached and stick lifted from its socket, placed in position in the torque tube ready for control of ailerons and elevators.

16. Signal Pistol Holster

(a) The holster, made of cowhide finish imitation leather, is located on left side of cockpit just forward of frame #8.

17. Cartridge Clips, Signal Pistol

(a) Provision for stowage of 9 Signal Pistol Cartridges is provided by installation of 18 Cartridge Clips attached to left side of cockpit between frames #8 and #9.

18. Oxygen Equipment

(a) Oxygen mask, bag, regulator, flow gage and manifold pressure gage are mounted on right side of cockpit, just aft of frame #7.

19. First Aid Kit

(a) A first aid kit, MSA Type D, Style C, is located on left side of the cockpit at frame #7.

20. Fire Extinguisher

(a) One carbon tetrachloride type fire extinguisher, one quart (1.057 liters) capacity, is located on a bracket attached to the left side of the fuselage, between frames #7 and #8.

(b) The fire extinguisher may be located from the outside by the marking painted on the fuselage skin: "Blandslukker Innerfor".

(c) See "Instruction Book", Walter Kidde & Co., Inc., and Section XXIII, for complete maintenance instructions.

21. Engine Cover

(a) One cover for engine is supplied with each airplane.

22. Tools

(a) The tools furnished by the propeller and the engine manufacturers, and those tools required for unusual or special use and not obtainable commercially, are supplied.

B. INSTALLATION

1. Pilot's Seat

(a) Draw back both pins in both brackets, bolted to frame #4-1/2, which is the aft side of the pilot's cockpit These pins are held in shut positions by springs and are on a level with and about 6 inches (15 cm.) inboard from each side of the cockpit. Turn knob of pin one quarter turn so that when released the pin will remain in the open position

(b) Lift the pilot's seat assembly into position and place the forked end of upright supports over or around the bolts in lower brackets on frame #4-1/2 at the floor line. Tilt assembly back until the eyed lips enter slots of upper brackets. Turn the knob of each pin so as to allow attached spring to draw pin through the eye thereby locking assembly in place.

2. Gunner's Seat

(a) Hold the seat lock release pedal in the down position.

(b) Lift the gunner's seat assembly into position and place the bearing pins through the mounting ring and into the brackets at the sides of the cockpit.

(c) Attach the bearing pins in place by bolting through the bracket.

3. Bomber's Compartment

(a) Remove from the middle, the two pins which hold the hinge; the stop brackets and the cable anchor bolts at the top and bottom of the compartment. Remove the clevis pin and pulley at the bottom.

(b) Place the compartment in position with the hinge in proper alignment with its mating part

(c) Replace the hinge pins at the center of hinge from outside the compartment.

(d) Attach the hoisting cable to the bottom of the compartment with the anchor bolt. Replace the clevis pin with the cable in place on the pulley.

(e) Fasten the extension cable with the anchor bolt provided.

(f) Replace and bolt the stop brackets on the sides of the compartment.

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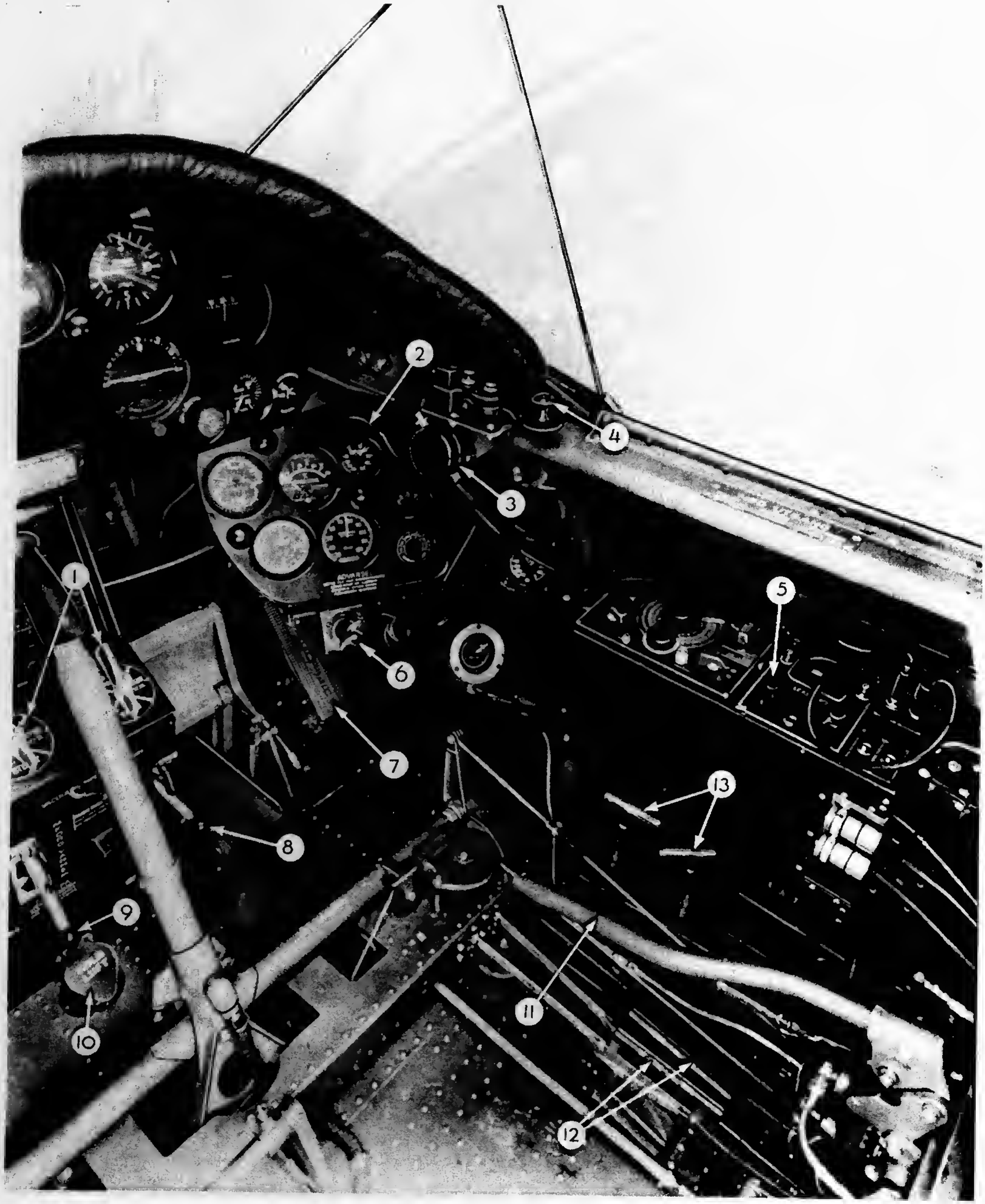
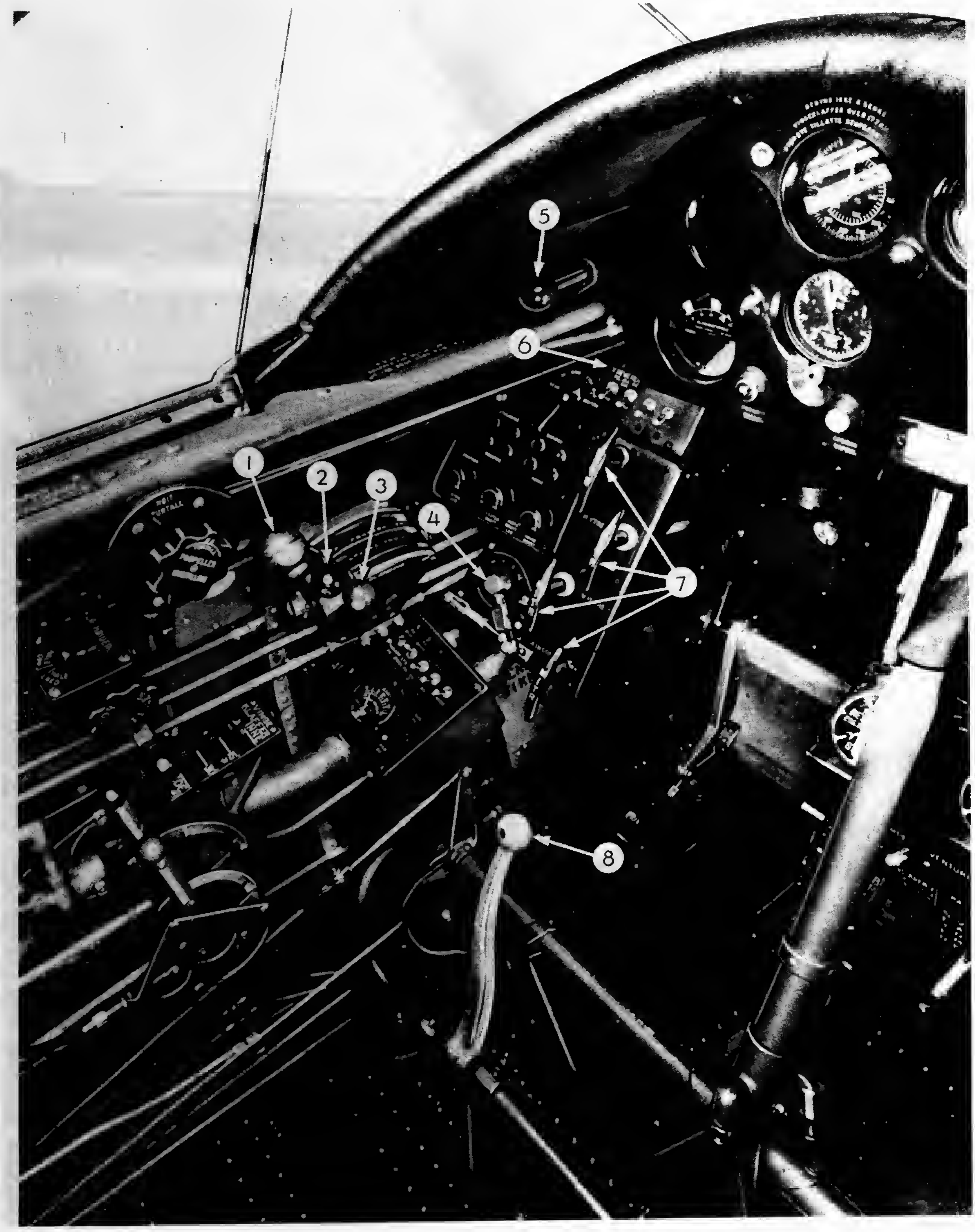
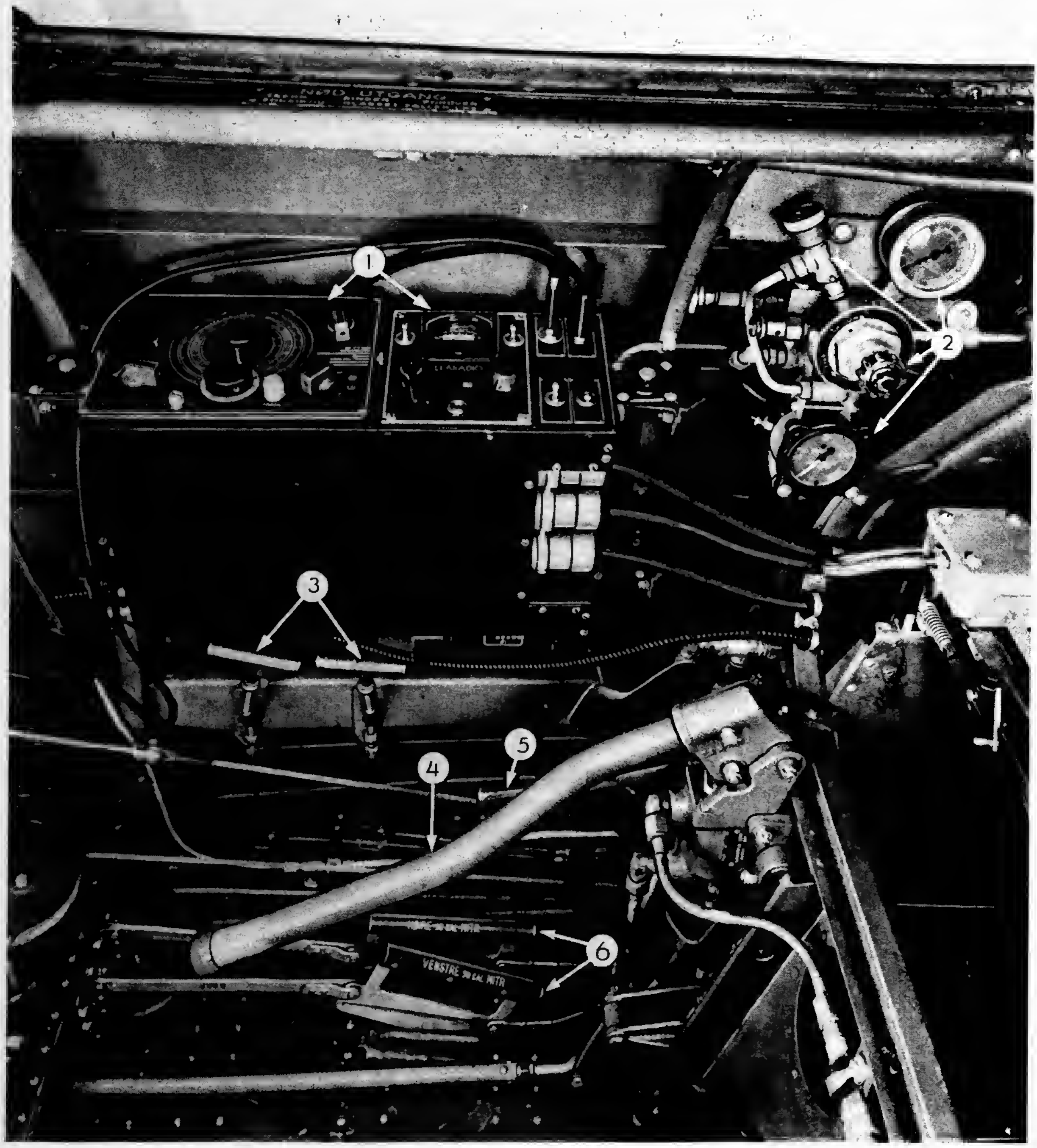


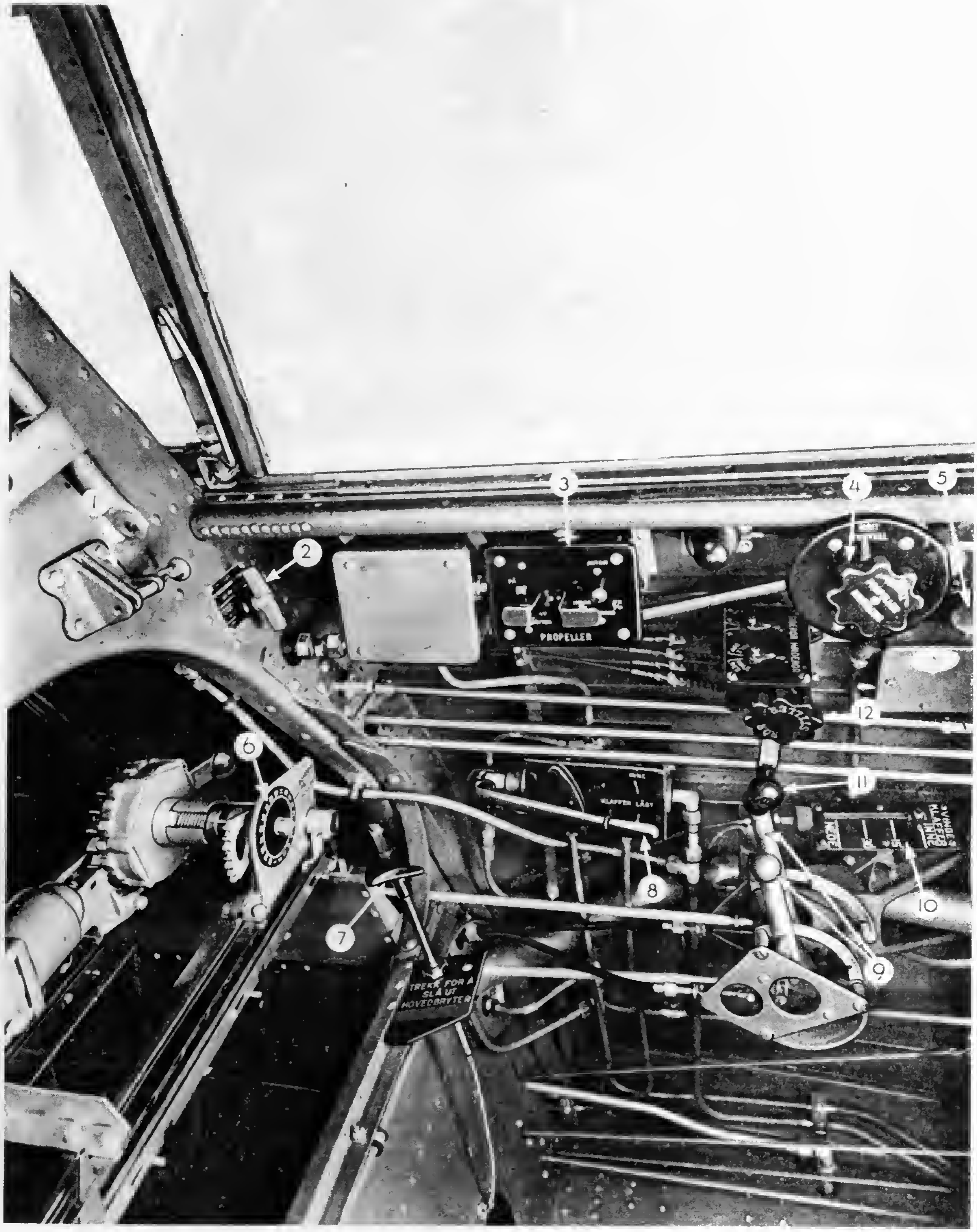
8363 - Front Cockpit - Right Front



8362 - Front Cockpit - Left Front

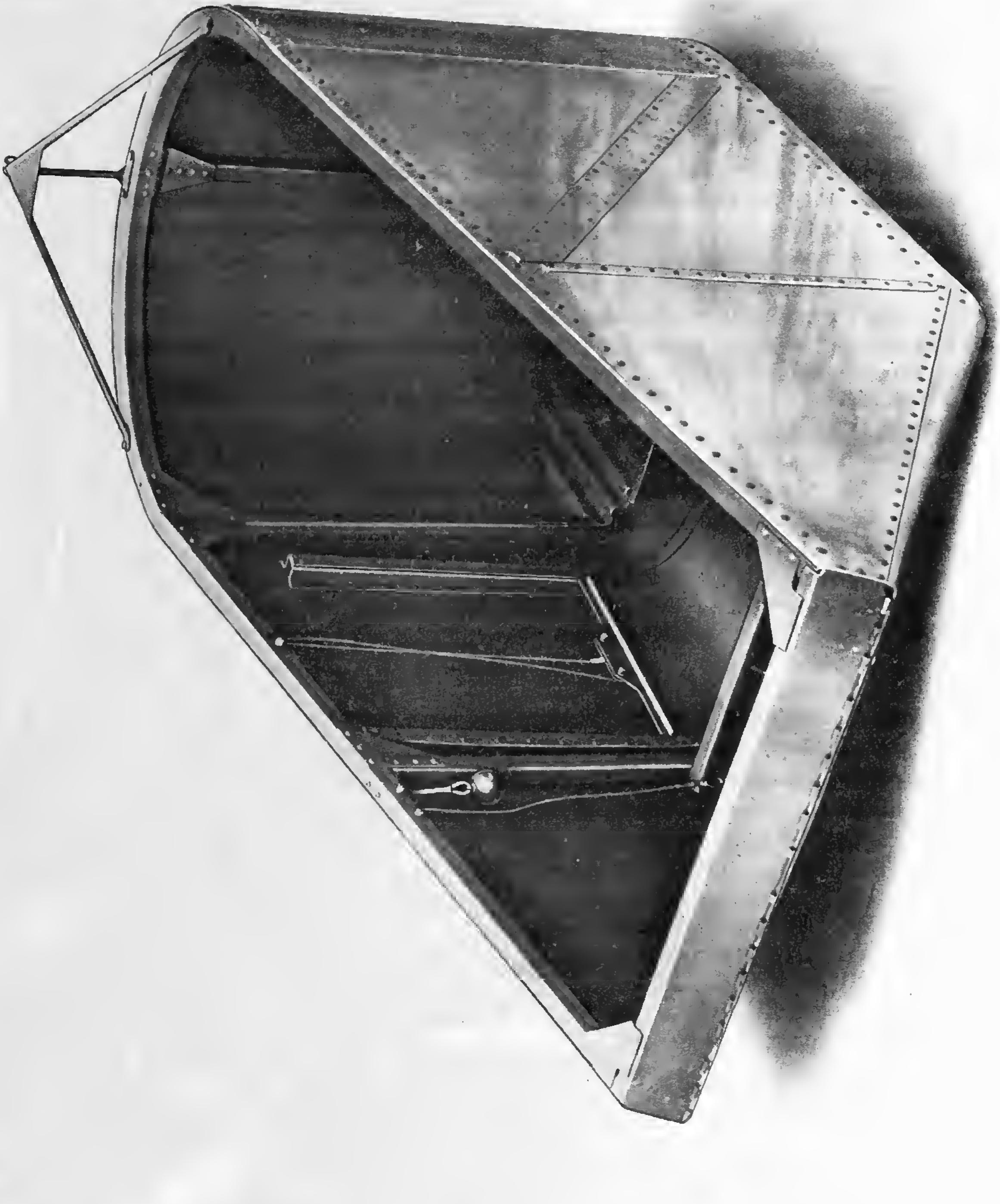


8408 - Front Cockpit - Right Rear

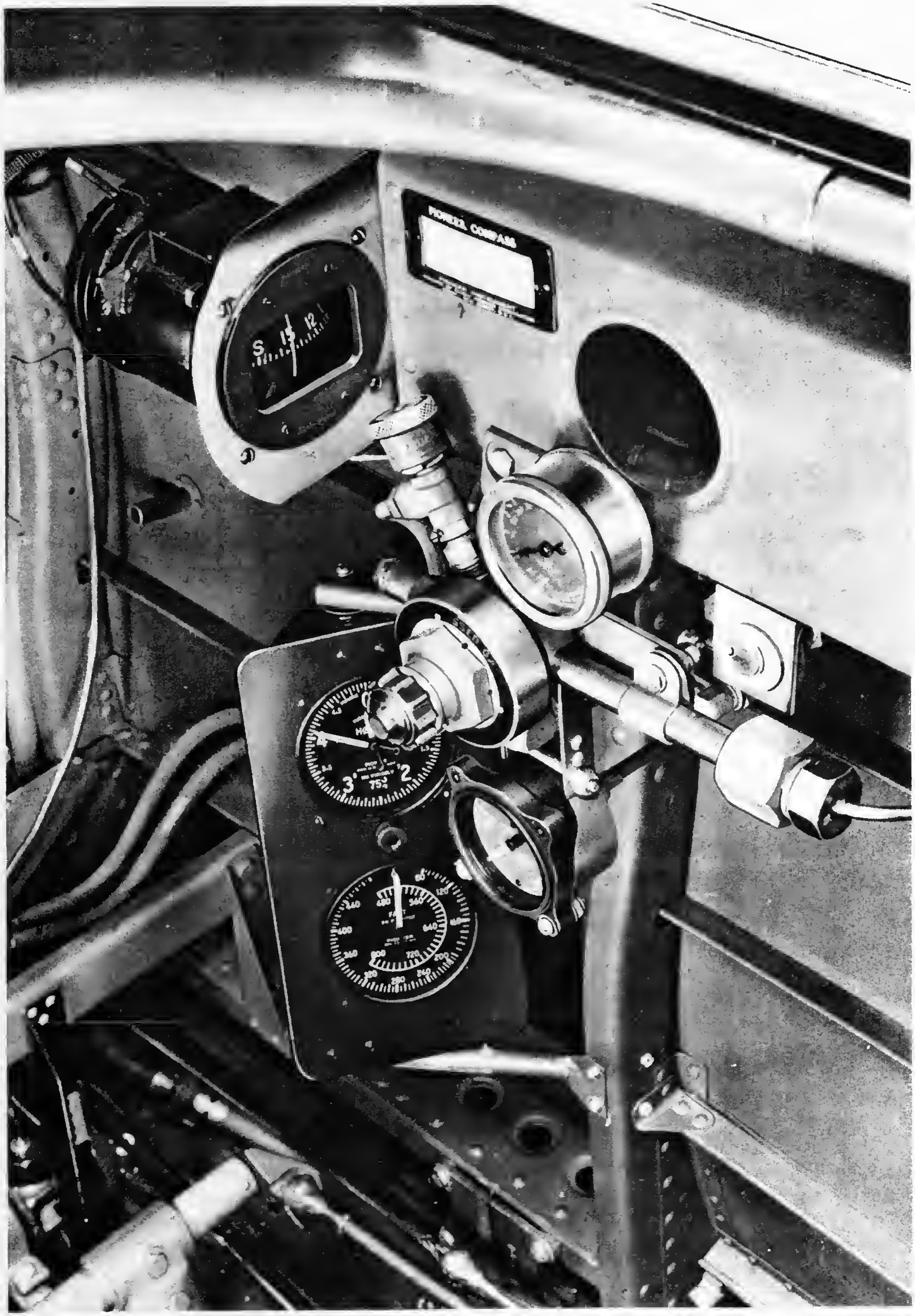


8410 - Front Cockpit - Left Rear

8451 - Rear Cockpit - Looking Forward



8116 - Bomber's Compartment



8376 - Flight Instruments - Rear Cockpit

SECTION XV

COCKPIT ENCLOSURES

A. DESCRIPTION

1. The cockpit enclosure is composed of two fixed and three movable sections. From fore to aft they consist of: The windshield, pilot's enclosure, center section, gunner's enclosure forward section, and gunner's enclosure aft section.

2. The windshield is made of three panels of laminated glass and is held in place by a clear vision frame. The front section of the windshield is curved and the two side sections are flat.

3. The pilot's enclosure is mounted on rollers in a track. This permits the section to be rolled back over the fixed center section to give access to the pilot's cockpit. The side panels are of laminated glass, the curved top section is of Plexiglass. A latch is located on the left side of the enclosure near the front, the handle of which provides a means of pulling the section open. A small lever projects through the lower left side of the forward end of the enclosure to the outside permitting the section to be unlatched and opened from the outside. The laminated glass side panels are hinged at the top and fastened by a pin at the bottom. Removal of the pin by pulling an easily identified ring affords an opening for an emergency exit.

4. The center section of the enclosure is stationary. This section forms part of the overturning bulkhead and is completely metal covered.

5. The gunner's enclosure, forward section is mounted on rollers in a track and rolls forward into the fixed center section. The side and top panels are of Plexiglass. A latch release handle is located on the cockpit stiffener on the left side of the fuselage. The enclosure may be opened by pulling the latch handle and then sliding the section forward. When the section has been pushed forward into the center section it may be locked so that changes in the longitudinal position of the airplane will not cause the section to slide to its aft or closed position, thus giving the gunner freedom of action. A lever extends through the left side of the fuselage so that the enclosure may be opened from the outside.

6. The gunner's enclosure, rear section, operates on rollers in a track and when pushed completely aft forms the rear fairing from the center section to the fuselage. All the panels are of Plexiglass. A latch release handle is located on the inside forward top of this section. To open: pull the handle and slide the section forward. An emergency exit can be accomplished quickly when the enclosure is closed, by pulling horizontally on the two red colored bars, located on each side of the lower inside portion of the section. These two red colored bars are marked "NØD UTLØSER". The section is then free to be removed thus affording an emergency exit.

7. When the forward and rear sections of the gunner's enclosure are open and locked, having been slid forward under the center section, they may be unlocked by pulling the latch handle on the left side of the gunner's cockpit.

B. INSTALLATION

1. Windshield.

(a) Place the three laminated glass panels into the rubber channel, which is held in place by an aluminum alloy frame riveted to the fuselage.

(b) Put the metal frame around the upper edge of the glass panels, guiding the long bolts through the holes in the fuselage skin at the same time. Be sure that the rubber channel is in place in this frame.

(c) Put the nuts on the ends of the long bolts and pull up firmly. Be sure that the glass panels are set firmly in the lower channel.

(d) Fill the seams between the front and side panels with commercial "Bostik" #292, or equivalent.

2. Pilot's Enclosure.

(a) Remove the 4 inch (10 cm.) sections of the tracks just forward of the fixed center section.

(b) Thread rollers of the enclosure into the tracks through this opening.

(c) Replace the sections of the tracks.

3. Gunner's Enclosure, Forward Section.

(a) Remove the stops at the rear ends of the outer tracks.

(b) Slide enclosure into the tracks and replace the stops.

4. Gunner's Enclosure, Rear Section.

(a) Remove the short vertical sections of the inner tracks.

(b) Slide the enclosure in place.

(c) Replace the sections of the tracks.

C. REMOVAL

1. Gunner's Enclosure, Rear Section.

(a) Remove the short vertical sections of the inner tracks.

(b) Slide the enclosure off the tracks.

2. Gunner's Enclosure, Forward Section.

(a) Remove the stops at the rear ends of the outer tracks.

(b) Slide the enclosure off the tracks.

3. Pilot's Enclosure.

(a) Open the enclosure about 6 inches (15 cm.)

(b) Remove the 4 inch (10 cm.) sections of the tracks just forward of the fixed center section.

(c) Slide the enclosure forward again and lift the rear rollers from the tracks.

(d) Pull the enclosure aft until the forward rollers can be lifted out of the tracks.

4. Windshield.

(a) Remove the nuts from the ends of the long bolts which hold the upper metal frame in place and remove the frame.

NOTE: Be sure that the three glass panels are properly supported during and after the removal of the frame.

(b) Pull the three glass panels out of the channel attached to the fuselage.

D. MAINTENANCE

1. Keep the track and rollers free from dirt and gum.

2. Check track and rollers daily for wear and binding.

3. Inspect the latches and latch release mechanism daily for proper operation.

4. Keep the glass and plexiglass clean.

5. Lubricate the rollers as indicated on Lubrication Chart (Airplane), page XXIII - 28.

8239 - Cockpit Enclosures - Open

8238 Cockpit Enclosures - Closed

SECTION XVI

BOMBS

(Mechanism, Installation,
Loading & Release)

A. DESCRIPTION

1. The bombing installation consists of 20 Internal Chutes and 8 External Racks with their operating mechanisms, interconnected. The external racks must be confined to one of the following loads:

   (a) Four - 225 kg. bombs or,

   (b) Eight - 50 kg. bombs.

2. Either pilot or bomber can control the selective (single) or salvo release of internal or external bombs in safe or armed conditions. The pilot only, can set the selector switch for internal or external bombs.

B. INTERNAL RACKS & CHUTES

1. (a) The internal rack is one unit, which carries the bombs in the chutes. This rack unit is mounted across the tops of four rows of stainless steel guide chutes. The chutes are located in the fuselage between the pilot's and the gunner's cockpits. Each row consists of five chutes, a total of 20 chutes in all. The rows are inclined 7° aft at their lower ends.

   (b) Each internal rack will carry five 9 kg. bombs.

   (c) An internal Bomb Load Indicator is located on the forward end of the release jackshaft. This indicator is a disc numbered from 1 to 20 and indicates the number of bombs on the racks. The indicator is visible to the pilot as it is located left and aft of pilot's seat.

2. Loading Internal Bomb Racks:

   (a) Check racks to see that no bombs are in racks.

   (b) Electrically operate rack until the electricity is disconnected by the automatic cut-out. This also occurs when the last bomb is released.

(d) Wind main spring by hand until fully wound as indicated by markings on shaft. (Red marking shows on shaft when winding is needed). Always wind after each cycle of discharge.

(e) Set all switch bars by hand.

(f) Return the release handle of the control unit to the "SELECTIVE" position and set the arming handle to "SAFE".

(g) Load the bombs through the lower end of the chutes. This requires one operator in the fuselage to guide each bomb upward in its chute, while the operator outside passes the bombs up through the chutes.

(h) The carrying lug on the tail of each bomb must be pushed upward in place against the rack carrying hook until the hook snaps closed. Be sure that the lug is held securely by the hook.

(i) Snap the ring ends of the arming wires into the slots provided. The hook in each slot may be displaced by hand to receive the arming wire ring.

(j) When all bombs are in place, set the release handle of the control unit in the "LOCKED" position.

3. Release Mechanism, Internal Racks:

(a) The internal bomb racks release their loads by means of an electric contact press button on the top of the control stick in the pilot's cockpit, or in the gunner's cockpit by an electric contact button on the end of an extension cord, the other end of which is plugged into the pilot director and camera junction box assembly, at connection marked "BOMB RELEASE". The press button release is held in the hand and the cord allows the gunner wide latitude of movement.

(b) Single release of bombs is accomplished by placing the release handle in the "SELECTIVE" position, the panel switch to "INTERNAL BOMBS" position and then by pressing the button on either control a bomb is released at each contact of the button or one at a time.

(c) The internal racks are timed to release from aft forward except when all bombs are to be released at once, release is then placed in "SALVO" position.

(d) The release control units also operate the "ARMED" and "SAFE" conditions of <u>both internal and external</u> <u>bombs</u>.

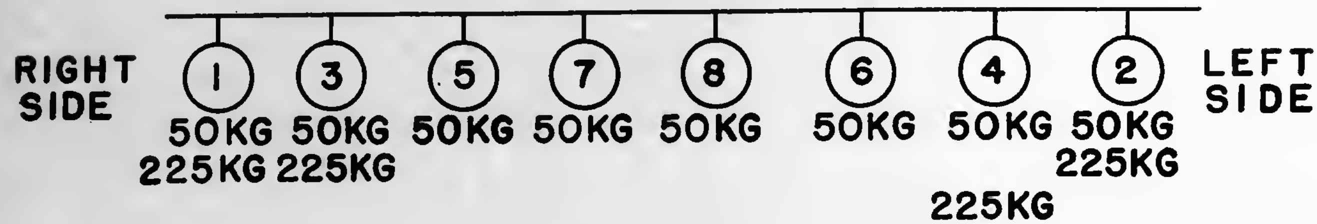
C. <u>EXTERNAL RACKS</u>

1. (a) External Racks are located below the center section of the wing. They will carry either of the following bomb loads:

   (1) Eight - 50 kg. bombs.

   (2) Four - 225 kg. bombs.

   (b) The locations of these loads are indicated in the sketch below and released in the following order:



   <u>NOTE</u>: Fourth 225 kg. bomb optional at position 4 with overload condition.

   (c) If loads are to be carried in <u>both</u> the internal and external racks, positions #7 and #8 on the external racks must be left vacant so that the internal bombs may drop without touching any of the external bombs. Consult Weight Loading Chart, page II - 7, prior to loading the airplane for a tactical mission.

   (d) Above each external rack is an electric switch operated by a plunger which extends downward to the cocking lever in each rack. When a rack is loaded the switch automatically closes and lights one of the eight amber lights on the pilot's electrical panel, left front side of cockpit. When a bomb is released, its corresponding light goes out. By observing the lights, the number and position of the bombs in the racks can be determined.

2. <u>To Load External Racks</u>:

   (a) Place the release lever of the control unit in the "SELECTIVE" position in the center of its quadrant, and place the arming lever in the "SAFE" position, aft on its quadrant.

   <u>NOTE</u>: Make sure that the carrying hook on each rack is fully released and ready to receive the lugs on the bombs.

(b) Loosen the lock nuts on the sway brace bolts for each rack and screw the bolts in as far as necessary to facilitate loading the bombs on the racks.

(c) Reset the release bar in the center section by pulling the loop ended lever toward the right side of the airplane as far as possible. This lever is accessible through a door beneath the center section.

> IMPORTANT: Be sure release bar is pulled full distance to right side.

(d) Set the bomb switch on the armament panel to the "OFF" position.

(e) The external bomb loading levers, located at the forward end of the bomb rack assemblies, must be tripped into the forward or uncocked position, opening the bomb carrying lug hook. This can be accomplished by reaching through the small hole in the rack fairing and pulling the small trigger with the finger. The tumbler, holding assembly cocked, is then released.

(f) Lift bomb up until lug on bomb is in position to be secured to the carrying lug hook, then pull loading lever aft, thereby drawing the bomb rack assembly forward until it reaches the locked position, thus securing the bomb.

(g) Draw back the arming ring latch and insert arming ring allowing latch to snap back into position securing the ring.

(h) After loading the external bombs, move the bomb release lever in the pilot's cockpit to the "LOCKED" position. Bombs are now in position to be dropped. If arming ring hook is closed when bomb is released the ring will stay in the hook thus causing the bomb to be set to "FIRE". If the arming ring is open when bomb is released the ring will leave with the bomb and bomb will not fire.

> NOTE: Holes in the fairing and racks permit visual inspection to insure that tumbler and latch are properly engaged.

(i) Screw sway brace bolts down snugly against the bombs and tighten the locknuts on the bolts.

> CAUTION: DO NOT FORCE THE BOLTS DOWN TOO TIGHTLY. To do so will apply a high initial load in addition to the weight of the bomb.

-5

3. Release Mechanism, External Racks:

(a) The external racks are controlled electrically by a solenoid and escapement mounted aft of web #3 in the center section and approximately on the centerline of the airplane. This mechanism controls the transverse movement of the release bar above the external racks. Movement of the bar to the left releases one bomb for each one inch (2.5 cm.) of travel. This motion releases the bomb rack triggers which extend upward through the center section. The triggers in turn release the tumblers holding the carrying hooks in the loaded position, thus dropping the bombs.

(b) External bombs may be released in salvo from either cockpit by moving the release lever to its extreme forward position, marked "SALVO". This motion releases the escapement and allows the spring loaded release bar to travel to the left in one swift motion instead of by one inch (2.5 cm.) increments.

(c) Arming of the bombs is controlled from either cockpit by arming, "A", lever of the bomb release unit. This lever moves another transverse bar which operates the hook holding each arming wire ring so that the wire is retained in the rack when control lever is in the "ARMED" position.

(d) When the arming lever is placed in the "SAFE" position, the retaining hook is clear of the wire ring which is then free to fall with the bomb.

(e) To release the external bombs electrically, place the switch on the electrical panel in the "ON" position. Set selector switch to "EXTERNAL". Then press the bomb release button on top of the pilot's control stick grip or the release button on end of extension cord in rear cockpit (when attached to socket marked "BOMB RELEASE") and bomb will be released.

NOTE: The release lever of the control unit must be in the "SELECTIVE" position. The arming lever may be "SAFE" or "ARMED".

D. INSTALLATION

1. Internal Bomb Racks:

(a) Installation is made by placing the rack assembly over the chutes and bolting it to side channels, care being taken to be sure that the roller arm of bell crank properly engages slotted arm of rack assembly. Check the proper operation of all phases of bomb release mechanism carefully.

2. External Bomb Racks:

(a) Each external rack is attached to the lower surface of the center section by eight 1/4 inch (6.3 mm.) bolts, threaded into fittings attached to the center section. There are no link or cable connections to be made.

(b) Racks must be installed in the exact locations as shown on drawing #5091137. Use correct length bolts as called for on drawing. The release bar in the center section should be fully cocked so that the release lever on each rack will engage its proper slot.

NOTE: Place a washer between the rack and center section at each mounting bolt except where doublers are on center section.

(c) Sway braces should be attached individually to the center section. Screw each mounting bolt loosely into the center section before connecting each pair of braces with the bolt near the lower ends. Mounting bolts of proper length must be used to prevent damaging the threads in the center section stop nuts.

(d) Test the mechanism several times to be sure of proper operation.

(e) To dismount the racks, remove the bolts attaching them and the sway braces to the center section.

E. MAINTENANCE

1. The push-pull rod linkage to the internal racks is provided with means for maintaining proper adjustment. Lock nuts, cotter pins and safety wire should be kept secure. The ball bearing ends are grease packed and require no lubrication.

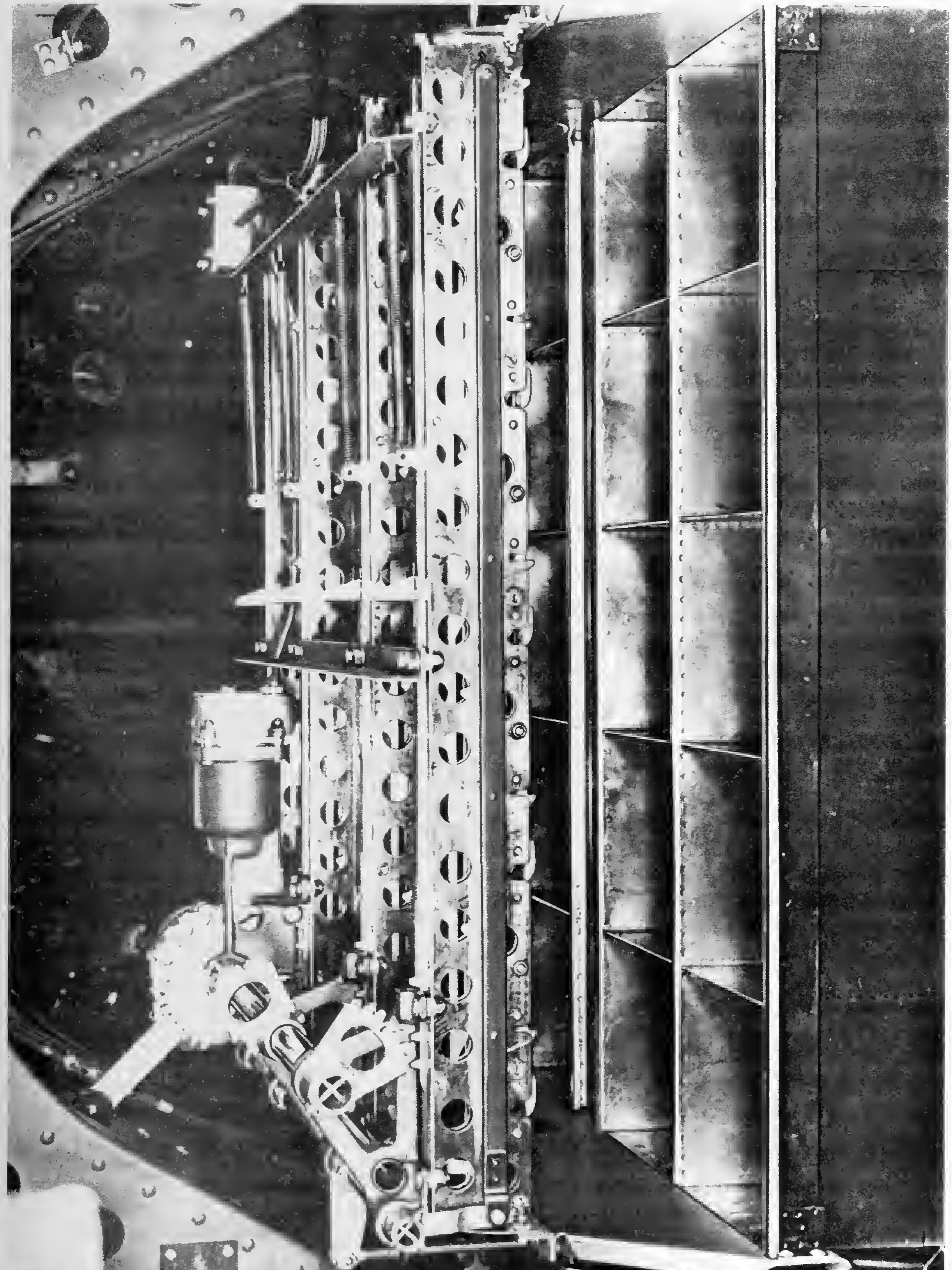
2. The release and arming levers on the pilot's bomb control unit are connected with the external release and arming bars by push-pull rods and flexible cables respectively. The rods and cables should be so adjusted that the levers move the bars the one inch (2.5 cm.) distance, as previously described. Screw ends and turnbuckles are provided in the rods and cables at the control unit to accomplish this adjustment.

3. Inspect daily all joints and working parts of the complete bomb carrying equipment.

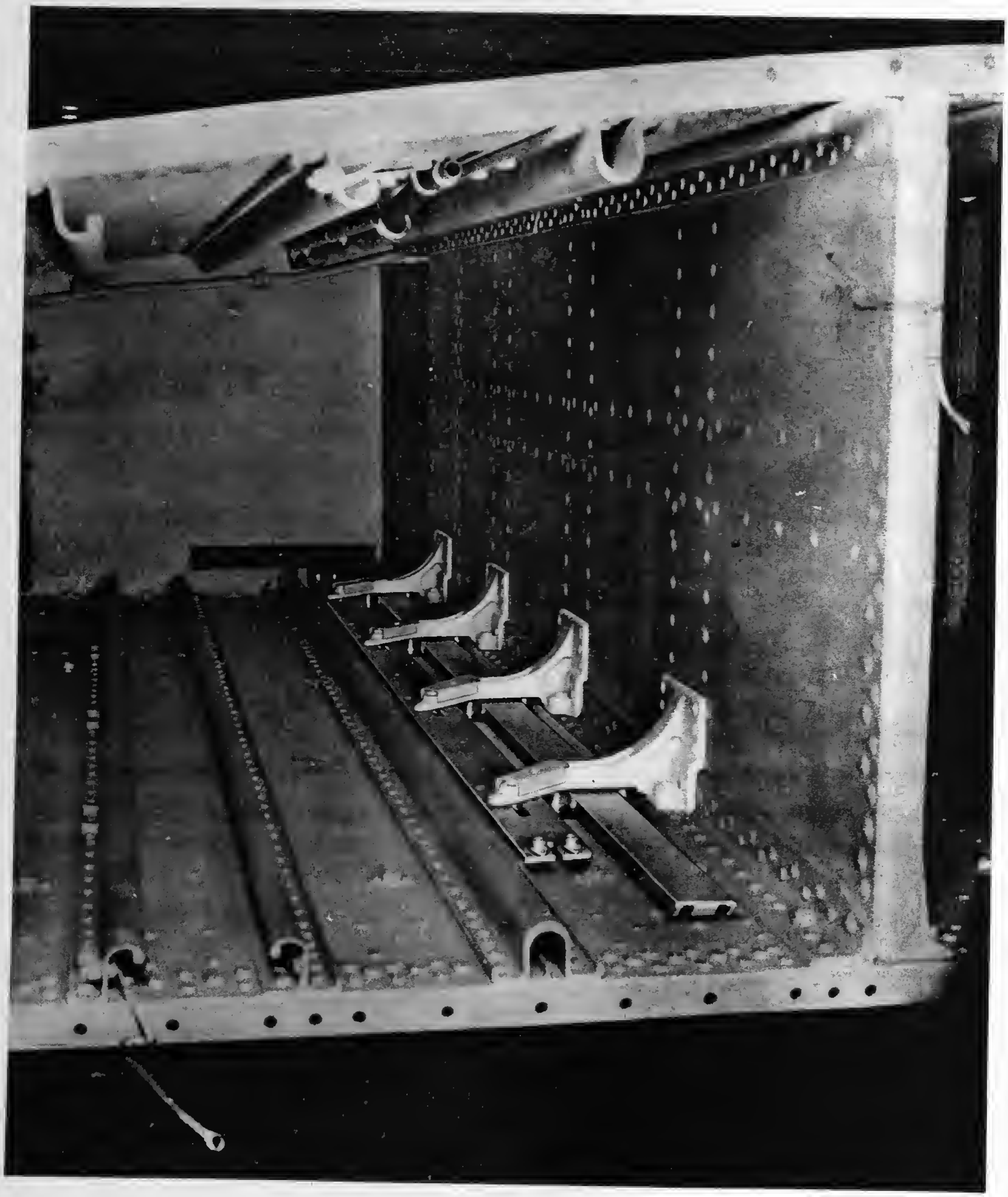
4. To prevent the collection of dirt, avoid unnecessary use of oil or grease.

5. Keep the equipment clean to prevent the accumulation of foreign matter liable to interfere with proper operation.

6. Make sure that electrical terminals are tight and free from corrosion.

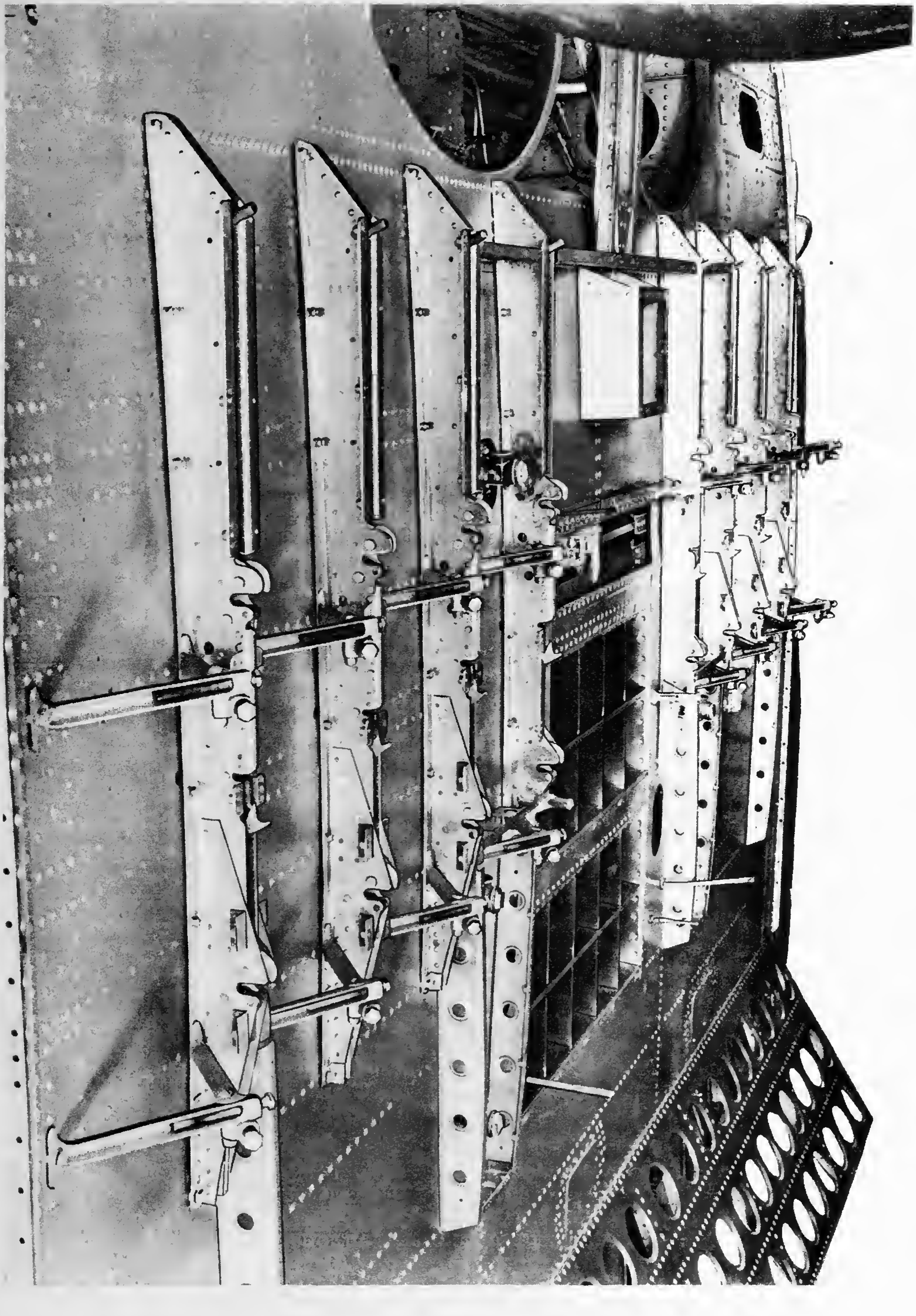


8223 - Internal Bomb Chute Installation



5609 - External Bomb Release Mechanism

8374 - External Bomb Release Mechanism - Front Cockpit



8225 - External Bomb Rack Installation - Fairing Removed

8365 - External Bomb Rack Installation - Fairing in Place

8401 - External Bomb Rack Installation - Bombs in Place

8375 - Estoppey Bomb Sight Installation

SECTION XVII

FIXED MACHINE GUNS

.30 CALIBER

A. DESCRIPTION

1. Provision is made for the installation of four .30 caliber Colt MG-40 machine guns, two in the leading edge of each wing, outside of the propeller disc. The muzzles project ahead of the leading edge of the wings approximately 8 inches (20 cm.). Covers are provided to close the openings in the wings when the guns are not in place and they are stowed on brackets in the wings when the guns are installed. Gun covers made of dural are provided to fit over the guns when installed but not to be fired and are stowed on brackets in the wings when not in use.

2. Drawer type ammunition boxes and chutes of stainless steel are removable through doors in the lower surface of the wing and provide, with the chutes, a total of 2000 rounds of ammunition. The boxes, which are interchangeable in all four positions, are provided with quick acting locks

3. Ammunition is fed to each gun over a ball-bearing roller in one upper corner of the box and down through a stainless steel feed chute with another similar roller at its lower end near the gun feedway.

4. A stainless steel link ejection chute leads the ejected links out of the wing through an opening underneath each gun. A trap door on the under surface of the wing, at that point, is provided with a catch which is operated by a small tension spring connected to the charging control of the gun it charges, so that the doors will open automatically during the first charging operation preparatory to firing that gun. It is not closeable in flight and must be closed by the armorer after landing.

5. The link chutes and case chutes are adjustable throughout the range of gun adjustment provided, but the ammunition box positions are fixed.

6. Rear post assemblies and trunnion bolt and bracket assemblies of special Douglas design are means by which the guns are mounted. Aluminum alloy forgings receive the rear posts and similar forgings are provided for the front trunnion posts. The latter are also braced with additional steel fittings to insure proper rigidity.

7. Adjustment range of guns as mounted, is possible as follows: Vertically; one degree elevated and two degrees depressed, referred to level flight at sea level with full load. Laterally; one degree right and one degree left from centerline.

8. High speed level flight at sea level requires a flying attitude of one degree down. For leveling see page III - 2.

9. A steel tube mount is installed on the top side of the fuselage in front of the pilot's windshield for the mounting of one type C-4 gun sight Mounting lugs permit moving the sight approximately 1 1/8 inches (2.8 cm.) left or right of centerline of sight. The C-4 sight may be adjusted to direct the gun fire within the range of adjustment provided for the guns See handbook for type C-4 Fixed Gun Sight, Douglas Aircraft Co., Inc.

10. Charging is accomplished by the use of four Douglas charging handle assemblies, one for each gun, located on the armament panel, left front side of pilot's cockpit Handles are connected to cables which run over ball-bearing pulleys, to the charging connections on the guns they serve Stowage springs are provided for belaying the cable ends, when guns are not mounted.

11. Fire control is obtained by a special 80 amp. electric switch in conjunction with a trigger switch. The electric switch is located at top of electrical panel left front side of pilot's cockpit. The trigger switch is mounted in the front side of the pilot's control stick grip. Current from the 80 amp. switch is led to trigger solenoids on the guns.

> NOTE: Guns may be made safe or a "run away" gun may be stopped by pulling charging handle to first notch and turning it either to right or left.

B. INSTALLATION (Reference Drawings #5091139, 5092612 & 5092615.)

1. To Install Guns In Wings:

(a) Remove the muzzle plates in the leading edge and the streamline covers on the under side of the wings, the latter being at the rear gun mounting brackets Open the access doors on the top surface of wings.

(b) Open the bottom access doors, remove the ammunition boxes, and the stowage rods connecting the feed chutes.

(c) Remove the trigger solenoids and install them on the guns.

(d) Install the trunnion bolt and bracket assemblies on the trunnion lugs of the guns and install the rear mounting bracket on the rear mounting lugs of the guns.

(e) Install the notched plates for the feed chute supports at the bosses on the guns near the feedways and insert the guns in the wings through the leading edge openings.

> <u>CAUTION</u>: Exercise care to prevent damage to the gun and wing structures while placing the guns. Make sure the mounting brackets are snugly down on the mounting posts and securely locked.

(f) Make the necessary alignment adjustments in accordance with tactical requirements as to direction of fire and safety all adjustments.

(g) Align ejection and feed chutes for proper operation and safety where required.

> <u>NOTE</u>: Feed chutes must be attached to plates on gun feedways, and ammunition boxes must be in place to insure that feed rollers in boxes are not subjected to interference by upper ends of feed chutes when adjustments are being made.

(h) Remove lower spring from stowage clip, connect one end to arm of door latch, the other end to the gun charging cable. Clip ends of stowage springs through the holes provided for them. Check the operation of cables by charging the guns, empty of ammunition, from the cockpit.

(i) Attach the wires to the trigger solenoid terminals as follows:

	WIRE NO.		TERMINAL		TERMINAL
L.H. Inb'd Gun	18E5	to	1		
L.H Inb'd Gun	18E4	from	1	to	4
R H. Inb'd Gun	18E9	to	1		
R.H Inb'd Gun	18E8	from	1	to	4
L H. Outb'd. Gun	18H5	to	2		
L H. Outb'd. Gun	18H4	from	2	to	8
R.H. Outb'd. Gun	18H9	to	2		
R.H. Outb'd. Gun	18H8	from	2	to	8

(j) Adjust the solenoids to release the firing sears on the guns and thoroughly test their operation electrically.

(k) Stow the gun covers in the wings.

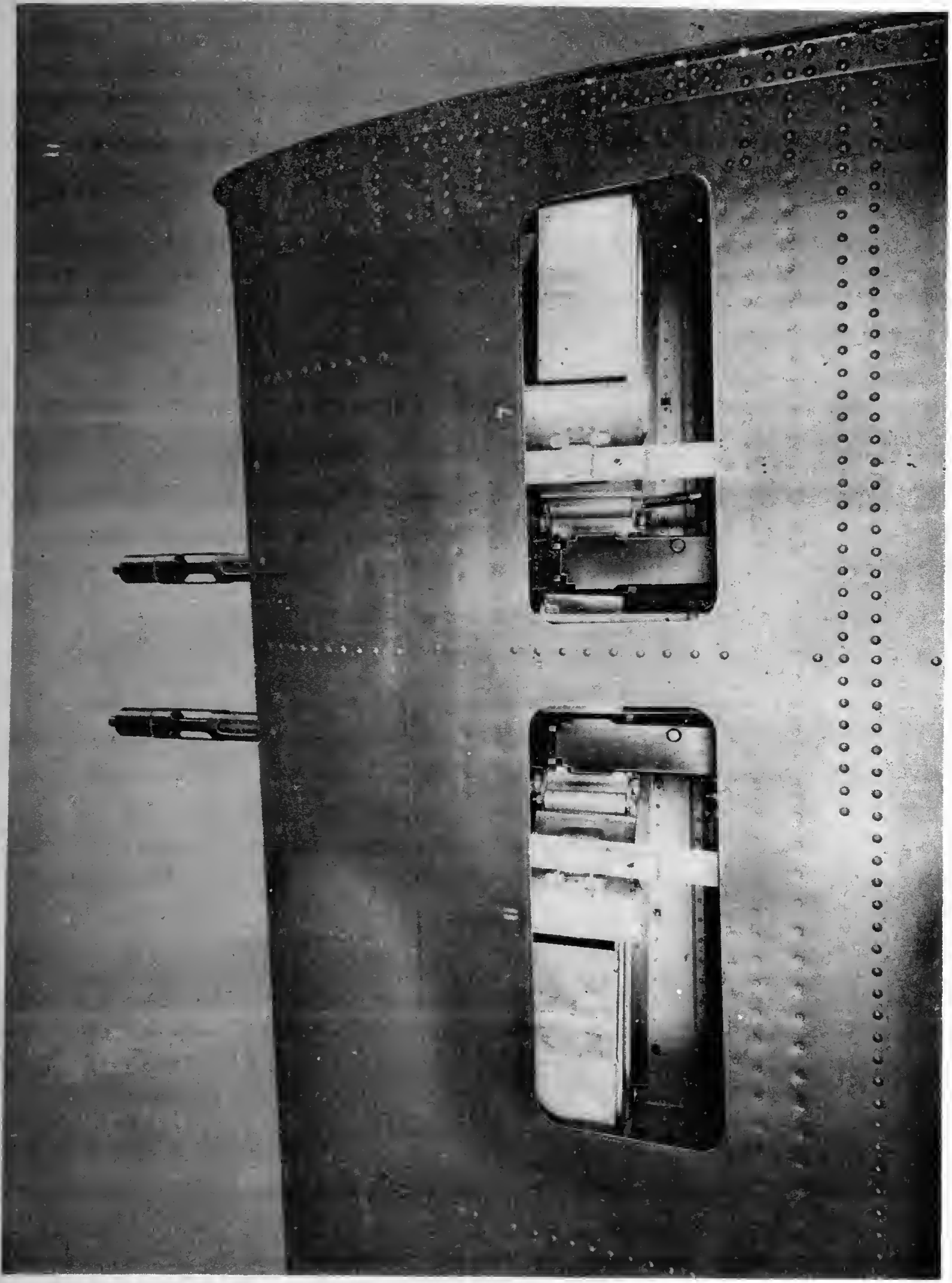
NOTE: If the guns are to be used, remove the ammunition boxes, fill and replace in the wings. Feed the ammunition over the feed rollers, down through the feed chutes and into the feedways of the guns, making certain that the first cartridge and link in each chute are properly engaged by the belt holding pawl in the gun feedway.

(l) Replace the access covers on top of the wings and close the lower access and the ejection chute doors.

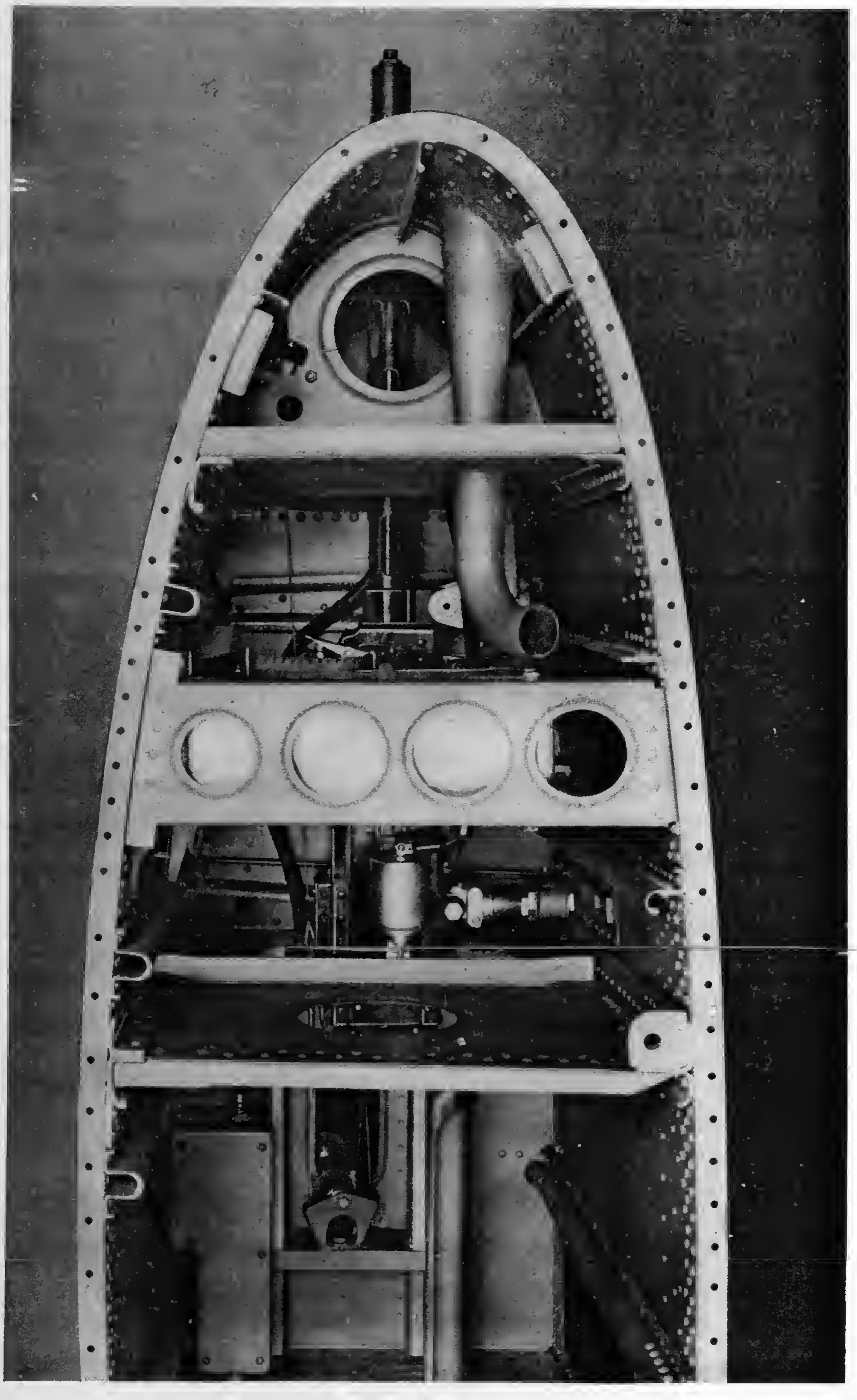
C. DISASSEMBLY

1. In general, the removal of the fixed guns may be accomplished by a reversal of the foregoing instructions pertaining to assembly. Extreme care must be taken to insure against accidental firing of the guns in case all ammunition has not been expended or in case of partial jams which have been caused by mal-functioning. Also, exercise care when removing guns so damage to structure and equipment will not result.

2. Parts to be stowed in the wings must be properly placed and safetied where necessary.



5650 - .30 Cal. Gun Installation - Top View



5651 - .30 Cal. Gun Installation - Side View

FIXED MACHINE GUNS

.50 CALIBER

A. DESCRIPTION

1. Provision is made for the installation of two .50 caliber Colt MG-53A Machine Guns at the attaching angle of each wing and between web #3 and #5. The muzzles project ahead of the fairing approximately 18 inches (45 cm.). The guns are mounted on their side. The gun mounted under left wing is a right hand feed and the gun under right wing is a left hand feed.

2. Drawer type ammunition boxes and chutes of stainless steel are **removable** through doors in the lower surface of the wing and provide, with the chutes, a total of 200 rounds of ammunition for each gun.

3. Ammunition is fed to each gun over a ball-bearing roller in one upper corner of the box and down through a stainless steel feed chute.

4. A stainless steel link ejection chute leads the ejected links out of the combat fairing into space or, if practice fairing is installed, into the practice fairing, through an opening in combat fairing underneath each gun.

5. The link chutes and case chutes are not adjustable, but are sufficiently large to allow full adjustment of guns.

6. Rear post assemblies, trunnion bolt and bracket assemblies, of special Douglas design are means by which the guns are mounted. Trunnion post and rear post are mounted in one mounting casting which is bolted into center section at center section attaching angle with four bolts. Two assemblies provide one casting for each center section attachment.

7. Adjustment range of guns as mounted, is possible as follows:

   (a) Vertically. One degree elevated and two degrees depressed, referred to level flight at sea level with full load.

   (b) Laterally. One degree right and one degree left from centerline.

8. **Charging is accomplished by the use of two specially** designed Douglas charging grips, located to the right of the pilot's seat. Grip handles are made of bakelite.

(a) To charge. Pull up vertically on forward hand grip.

(b) To make safe, or a "run away" gun may be stopped by pulling up on rear grip with a circular motion about the forward pivot to a point approximately 90° in reference to the cockpit floor.

9. Fire control is obtained by two special 20 amp. electric toggle switches in conjunction with a trigger switch. The electric switches are located above and to the right of the .30 caliber gun switch, located on top of electrical panel left front side of pilot's cockpit. The trigger switch is mounted in the front side of the pilot's control stick grip Current from the 20 amp switches is led to trigger solenoids on the guns.

10. Combat fairing is attached to the under side of the center section and wing by screws. An opening underneath the gun permits ejected links and cases to fall through fairing into space.

11. Practice fairing is attached to the combat fairing and can only be used in conjunction with combat fairing This fairing acts as a receptacle for ejected links and cases which may be used again.

B. INSTALLATION (Reference Drawing #5091559)

1. Remove outer section of fuel line and bomb fairing which is held in place by screws. Attach mounting casting. Attach charging pulley bracket outside of wing. Remove charging cable from belaying spring and string through pulley. Install combat fairing except the two removable sections on outboard side. Mount gun in position on bracket. Attach charging cable to gun charging slide. Attach gun solenoid and conduit assembly to gun. Push conduit through hole in wing, plug in at junction box on bulkhead #2. Install rear removable section of combat fairing. Install front removable section of combat fairing after closing ammunition box access door. Practice fairing to be attached only after the foregoing operations.

2. Make the necessary alignment adjustments in accordance with tactical requirements as to direction of fire and safety all adjustments, before installing front removable section of combat fairing.

3. Attach the wires to the trigger solenoid terminals as follows, and refer to Douglas Drawings #5092669 & #5092670:

	WIRE NO.		TERMINAL		TERMINAL
L.H. Wing Gun	18L8	from	2	to	Ground
	18L7	from	2	to	2
	18L4	from	1	to	1
	18L3	from	1	to	1
R H Wing Gun	18R7	from	2	to	Ground
	18R6	from	2	to	2
	18R3	from	1	to	1
	18R2	from	1	to	1

(a) Adjust the solenoids to release the firing sears on the guns and test thoroughly their operation electrically.

(b) If guns are to be used remove the ammunition boxes, fill and replace in the wings. Feed the ammunition over the feed rollers, down through the feed chutes and into the feedways of the guns, making certain that the first cartridge and link in each chute are properly engaged by the belt holding pawl in the gun feedway.

C. DISASSEMBLY

1. In general, the removal of the wing guns may be accomplished by a reversal of the foregoing instructions pertaining to assembly. Extreme care must be taken to insure against accidental firing of the guns in case all ammunition has not been expended or in case of partial jams which have been caused by mal-functioning. Also, exercise care when removing guns so that damage to structure and equipment will not result. Fasten charging cable and safety if necessary.

D. MAINTENANCE (.30 and .50 Caliber Guns)

1. For complete maintenance of the guns refer to the Colt Machine Gun Manual.

2. Maintenance of related equipment consists principally of maintaining proper alignment and keeping the entire installation clean and all brackets and adjustments tight and properly safetied.

3. Wear of feed chutes and ammunition boxes, if serious, will require the replacement of worn parts by new ones.

4. Worn or frayed charging cables should be replaced, and all electrical wiring kept in good order.

5. Grease and oil should be kept cleaned out of the wings in the area of the .30 Caliber Guns; within the combat fairing of the .50 Caliber Guns, and all parts affecting the functioning of all guns. There are no oiling operations required on the installation equipment since all bearings are dust free and grease packed by the manufacturers.

6. Wing areas, combat and practice fairing areas affected by powder must be kept painted and clean.

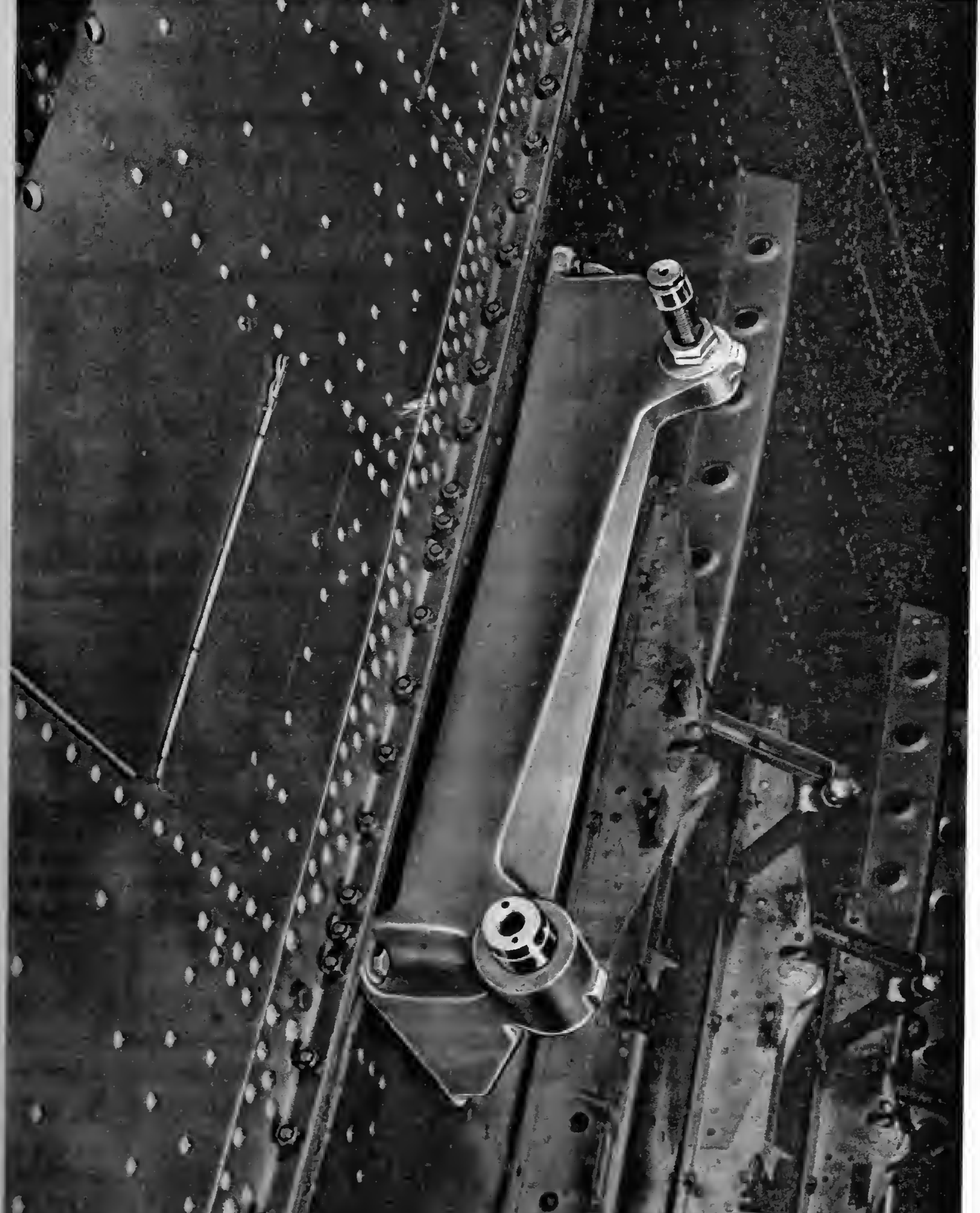
7. Case ejection chutes of the .30 Caliber Guns must be adjusted properly against or close to, the lower side of the guns to prevent jamming of ejected cases and links at that point.

1. Combat Fairing 2. Practice Fairing

8337 - .50 Caliber Gun Installation

8336 - .50 Caliber Gun Installation - Combat Fairing Only

8499 - .50 Caliber Gun Installation - Fairing Removed



8305 - .50 Cal. Gun Installation Wing Attachment

8222 - Charging Cables & Pulley Brackets, Left Wheel Well

SECTION XVIII

FLEXIBLE MACHINE GUN

A. DESCRIPTION

1. A 30 caliber Colt MG40 flexible machine gun is mounted on a carriage or truck, rolling on a sector track which is attached to a circular tiltable ring upon which the gunner's seat is free to rotate through 360°.

2. The gun truck will move through an arc of 98° (49° either side of center) and due to the adapter assembly upon which the gun is mounted to the post, the gun may also be rotated through an arc limited only by the agility of the gunner.

3. The adapter also permits rotation in a vertical plane. This action in connection with the tiltable ring allows the gun to be fired approximately 82° vertically, referred to the fuselage axis, when the gunner is facing aft and also makes possible a 62° angle of depressed fire over the sides of the cockpit.

4. A pedal, convenient to the gunner's left foot when facing aft, controls the two spring loaded doors over the gun tunnel in which the gun is stowed when not in use. Pressure on the pedal opens the doors.

5. The gunner's seat is adjustable vertically, by pulling the latch under lower front edge of seat. Shock cords attached to both sides of the seat raise it and the weight of the gunner lowers it.

6. A pedal, convenient to the gunner's right foot when facing aft, operates a pair of latches, one on either side of the seat ring. These latches disengage holes in sector brackets on either side of the seat ring, for tilting the gunner's seat fore or aft.

7. A spring loaded latch secures the seat itself in position when facing fore or aft and may be held unlocked to allow for complete rotation of the seat on the ring.

8. The seat may be tilted approximately 11° aft while facing forward, when the gun is stowed. This permits a comfortable seating position for the gunner when the gun is stowed in its tunnel.

9. The seat support tubes are hinged so that they may be unlatched, and the seat swung forward 82° and locked clear of the gunner when the bombers compartment is to be used.

   NOTE: Before the seat can be tilted it must be completely down and should be locked facing aft in order to clear all equipment.

10. Ten magazine holders are provided for carrying ten ammunition magazines. This gives a capacity of 1000 rounds for the flexible gun.

B. INSTALLATION (Reference Drawing #5091140)

1. The seat ring pivots on two hollow pins tapped to receive a pulling stud with 5/16 inch (7.9 mm.) 24 thread. A 5/16 inch (7.9 mm.) bolt may be used as a puller stud to remove them. They are safetied in place with a 3/16 inch (4.7 mm.) bolt and nut. The seat and gun truck assembly may be installed or removed as a unit, since the assembly is secured entirely by these two hollow pins.

2. To Install the Flexible Gun

   (a) Attach adapter and stowage latch (with spring) to the gun.

   (b) Rotate the knurled ring on top of gun post to the "OPEN" position.

   (c) Insert the shank of adapter into the gun post on the truck.

   (d) Rotate the knurled ring on top of gun post to the "LOCKED" position.

3. The flexible gun is equipped with suitable sights.

C. DISMOUNTING THE FLEXIBLE GUN

1. Reverse the instructions for installing the gun.

D. STOWAGE OF THE GUN IN THE GUN TUNNEL

1. Place the gun track and seat ring in approximately a level position.

2. Release the latches holding the gun post in a vertical position against the gun truck.

3. Raise the doors over the gun tunnel by depressing the pedal with the left foot, when facing aft (right side of fuselage) and lower the gun into position. Make sure that the muzzle enters the socket in the rear of the tunnel and that the latch pins engage the holes provided for them near the knurled ring on the gun post.

E. RAISING THE GUN INTO POSITION FOR ACTION

1. Release the latches holding the gun and post in the stowed position.

2. Open the gun tunnel doors by depressing the pedals with the left foot when facing aft, and pull the gun up until the latches on the gun truck engage the holes in the post.

3. Attach the ammunition magazine to the left side of the gun making sure the first cartridge is in place in the spring clips on the side of the magazine.

D. MAINTENANCE

1. No maintenance operations should be necessary except for the frequent inspection of all parts for defects or wear and occasional thorough cleaning to prevent accumulation of dirt, etc.

2. Loose joints and bolts should be tightened and safetied or worn parts replaced.

3. Looseness of the gun truck on its track will result in denting of the rollers and track due to the recoil action of the gun. Bearings in these rollers are dust protected and grease packed, so require no further lubrication.

4. Turnbuckles in the control cables to the latches and to the gun tunnel doors should be properly adjusted and safetied and the pulleys over which they run should be inspected for wear and binding.

5. See page XXIII - 28 for lubrication of the gunner's seat ring.

8355 - Flexible Gun Installation - Stowed

8356 - Flexible Gun Installation - Firing Position

SECTION XIX

PYROTECHNICS

A. DESCRIPTION

1. Landing Flares

(a) Provision has been made for carrying two Air Corps Type M8 landing flares, in two Type A-3 flare racks. The flare racks are installed in line between frames #12 and #13. They are inclined approximately 6° aft at their lower ends.

(b) The racks are tubular and have hinged covers top and bottom.

(c) Each top has a spring latch, operated only by hand. The eye end of the flare snub cable is held to the top by a spring loaded pin. The snub cable is attached to the top by sliding the spring loaded pin through the eye of the pin. The other end is snapped into the flare hangwire ring.

(d) The bottom covers are hinged and are held closed by sliding latches which are connected by cables to the two Type A-3 release handles, located between frames #3 and #4, pilot's floor, right side of seat. By pulling up a handle a flare is released.

CAUTION: Do not release landing flares at an air speed in excess of 150 m.p.h. (241 k.p.h.)

(e) A hinged cover in the top skin of the fuselage, directly over the racks, permits loading or removal of flares. The cover is secured by two Dzus fasteners.

(f) The two spring loaded doors in the bottom skin of the fuselage, through which the flares are dropped, are directly below the racks.

2. Signal Pistol Holster

(a) A Signal Pistol Holster is attached to the left side of the fuselage, rear cockpit, between frames #7 and #8.

3. Signal Pistol Cartridge Clips

(a) Cartridge Clips for the stowage of nine (9) Signal Pistol Cartridges are attached to the left side of the fuselage, rear cockpit, between frames #8 and #9.

B. INSTALLATION

1. Landing Flares

(a) To install a landing flare:

(1) Make sure that the release door on bottom of each rack is securely latched.

(2) Open the top cover of the rack to be loaded.

(3) Slide the flare slowly into the rack until it rests on the release door.

(4) Snap the flare snub cable to the ring on the hangwire at the top of the flare.

(5) Connect snub cable eye with pin in top cover.

(6) Coil cable over top of flare and close the top cover.

WARNING: Do not lower by hangwire.

(b) To remove a landing flare:

(1) Services of two men necessary.

(2) One man to open the lower door in the fuselage and prevent the flare from dropping as, -

(3) The second man pulls the release handle in the pilot's cockpit thus unlatching the bottom door of the rack.

(4) While the first man is holding the flare flush with the bottom of the rack, the second man leaves the pilot's cockpit, opens the door over the racks in the top of the fuselage and the top cover of the rack from which the flare is to be removed.

(5) Second man next disconnects pin from eye of snub cable as first man below pushes the flare up through the rack until it is securely grasped and removed by the second man above.

<u>CAUTION</u>: Flares weigh 20 pounds (9 kg.) each and the man at the lower or release door must be alert to avoid dropping the flare from its rack.

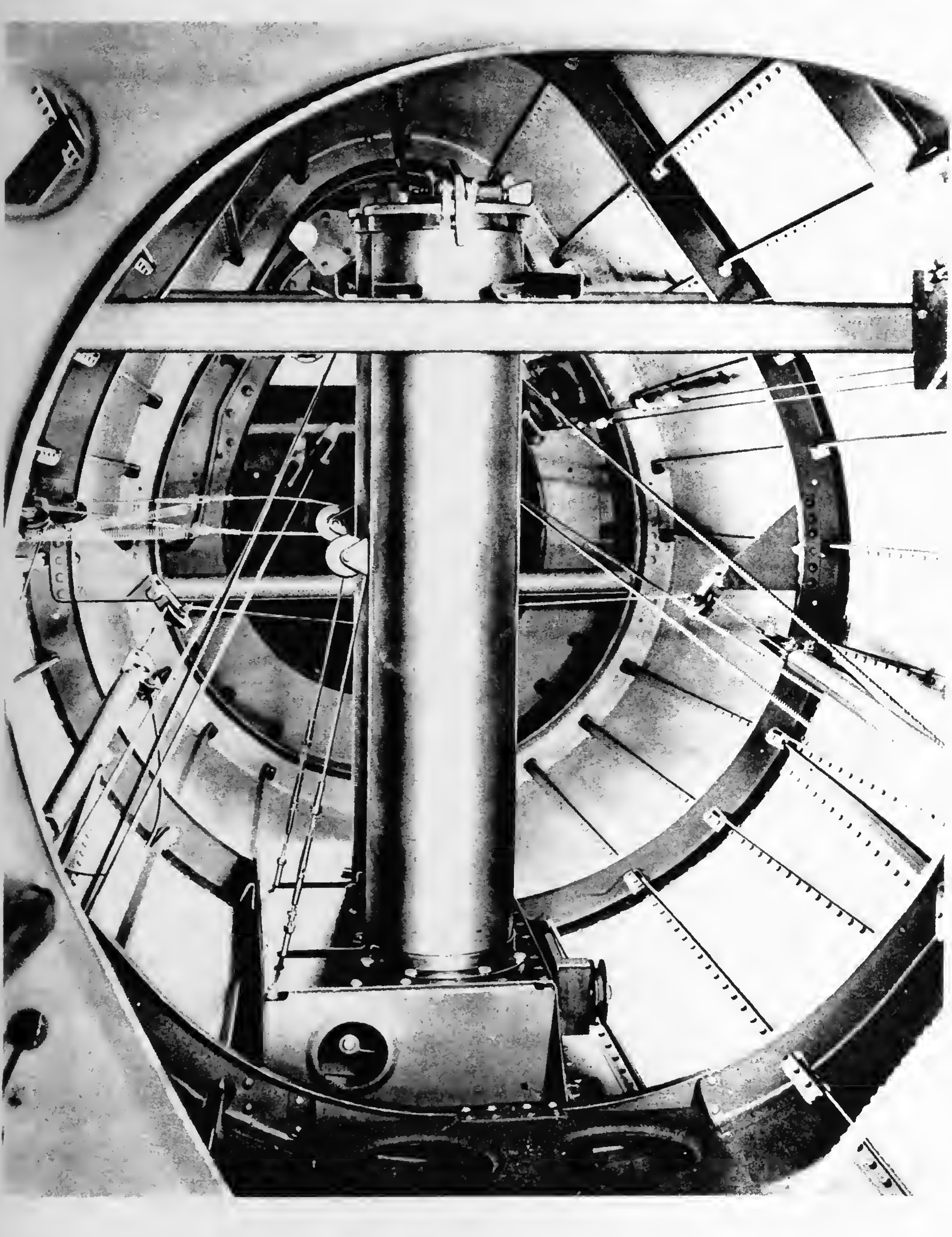
(c) The two Type A-3 flare racks are held in place by eight bolts and to fasten or release them it is necessary to enter the rear of the fuselage through the gunner's cockpit.

(d) The turnbuckles on the release cables provide means of adjusting the release mechanism of the racks.

(e) Always leave 1/2 inch (1.2 cm.) slack in release cables at their lower junction to the latches of flare racks.

C. <u>MAINTENANCE</u>

1. See Section XXIII for inspection of flares and flare releasing mechanism.



8338 - Parachute Flare Cases Installation

SECTION XX

FLIGHT (SURFACE) CONTROLS

A. DESCRIPTION

1. General

(a) This airplane has dual rudder, elevator, aileron and engine controls, for operation from either pilot's or gunner's cockpit.

(b) Additional controls for the operation of the rudder and elevator tabs, the brakes and the landing flaps are located in the pilot's cockpit only.

(c) The ailerons and elevators are operated by a conventional stick and torque tube control and are mounted on ball bearings.

(d) Flexible steel cables guided by ball bearing pulleys are used throughout the flight control system.

(e) The brake system and landing flaps are hydraulically operated.

2. Rudder & Rudder Tabs

(a) The rudder is the balanced type, has a movement of 30° each side of neutral, controlled by interconnecting foot pedals located in front and rear cockpits. The pilot's foot pedals are adjustable and by exerting pressure on the small lever attached to the inboard edge of each rudder pedal, the pilot may, through a limited range, adjust the pedal distance from his seat to accommodate his leg length. The pilot's pedals have individual toe pedals for operating the wheel brakes. Gunner's foot pedals can be disconnected from the cables and locked inoperative.

(b) Rudder control cables extend from the pilot's pedals, along the sides of the fuselage to the gunner's pedals, then into the aft of the fuselage to their connection with the cables operating the tail wheel steering mechanism and continuing aft to the rudder. See page XX - 6

(c) The controllable rudder trim tab, hinged to the trailing edge of the rudder, moves 10° to the right and 10° to the left. It is operated by cables from a hand control gear box in the pilot's cockpit only. See page XX - 8.

NOTE: The irreversible gear box is mounted on the left side of the pilot's cockpit and contains the controls for both the rudder tab and the elevator tabs. The rudder tab is operated by turning the knob, and the elevator tabs by turning the crank.

3. Elevators and Elevator Tabs

(a) The elevators are the balanced type and have a movement of 30° up and 20° down. Controllable trim tabs are hinged to the trailing edge of the elevators and have a movement of 10° up and 10° down. See page XX - 7, and XX - 8.

(b) Elevator control cables extend from the pilot's control stick torque tube, along the sides of the fuselage to the gunner's control stick torque tube, then into the aft of the fuselage to their connections at the elevators. Ball bearing pulleys are provided wherever the cables change direction.

(c) The elevators are controlled from either cockpit by the control sticks which are inter-connected by cables. The rear control stick can be quickly removed from its socket and strapped diagonally across the left side of the rear cockpit between frames #7 and #9. The rear torque tube can be released from the elevator control cables and locked inoperative.

(d) The controllable elevator trim tabs are operated by cables from a hand control gear box in the pilot's cockpit only. See NOTE, paragraph A, 2, (c), this section for operation of gear box controls.

(e) A pair of locks is provided for the front control stick and rudder pedals when the airplane is parked. To set the locks, see page XX-14.

4. Ailerons

(a) Frise slotted type ailerons are used. They have an angular movement of 21° up and 14° down from centerline of wing. See diagram, page XX - 9.

(b) Metal balance tabs are attached to the trailing edge of the ailerons. These are not adjustable from the cockpit and must be adjusted while the airplane is at rest on the ground.

(c) The aileron cables pass through the center section and wings to the ball-bearing actuating units in the wings. These units operate push-pull rods to the aileron horns.

5. Landing Flaps

(a) Hydraulically operated split trailing edge flaps are fitted to the wings inboard from the ailerons and to the center section. They have an angular movement of approximately 45° down. A selector valve which directs flow of hydraulic fluid to landing flap mechanisms is located in the front cockpit. The pressure for operation is supplied by either the engine or hand pressure pumps. See page XIV - 9 and 10.

B. ADJUSTMENT

NOTE: The following is the approximate tension to which the flight control cables are rigged. Tension is obtained by the use of a tensiometer at 70°F. (20°C.)

Rear Rudder Cables	80 lbs.(36 kgs.
Tail Wheel Steering Cables	100 lbs.(45 kgs.
Forward Rudder Cables	180 lbs.(81 kgs.
Elevator Cables	80 lbs.(36 kgs.
Aileron Cables	60 lbs.(27 kgs.
Trim Tab Cables	50 lbs.(23 kgs.

1. Rudder (Refer to Diagram on page XX - 6.)

(a) Adjust the cable lengths by means of the turnbuckles so that when the rudder pedals are in neutral, the rudder and tail wheel are parallel to the centerline of the fuselage.

(b) The cables between the front and rear pedals should be adjusted so that the rear pedals are in the same relative position as those in the front cockpit.

(c) To adjust the cables to their proper tension, first apply 110 lbs. (50 kgs.) on the tail wheel steering cables then adjust the rear rudder cables to 80 lbs. (36 kgs.).

(d) Adjust the rudder pedal stops at the front rudder pedals so that the rudder has a movement of 30° to each side of the centerline of the fuselage.

(e) The rudder tab cables should be adjusted by means of the turnbuckles, so that when the tab is in neutral the indicator on the control box in the pilot's cockpit indicates 0°.

2. Elevators (Refer to Diagram on page XX - 7.)

(a) With the elevator control stick in its neutral position, adjust the cable lengths by means of the turnbuckles so that the elevators are also in neutral.

(b) The elevators are set at the factory to give an angular movement of 30° up and 20° down.

> NOTE: There are four adjustable eccentric stops under the pilot's floor to make adjustment for installation discrepancies only, and should not be changed unless a new pilot's floor assembly is installed. In that case adjust so that both control horns hit their respective stops simultaneously.

3. Ailerons (Refer to Diagram on page XX - 9.)

(a) Have the control stick in its neutral position, rig the ailerons with their trailing edges 3/8 inch (.95 cm.) below the trailing edge of the wing.

(b) The stops at the base of the control stick in the front cockpit should be adjusted so that the ailerons have an angular movement of 21° up and 14° down.

4. Landing Flaps

(a) Adjust the flap links so that the flaps just touch the trailing edge of the wings when the operating cylinder is fully retracted.

> CAUTION: While testing do not pump the flaps clear up until it is certain that the operating cylinder bottoms just as the flaps close. If the flaps close first, damage to the structure will result.

C. MAINTENANCE

1. Check the system thoroughly ever 20 hours for the following:

(a) Frayed cables.

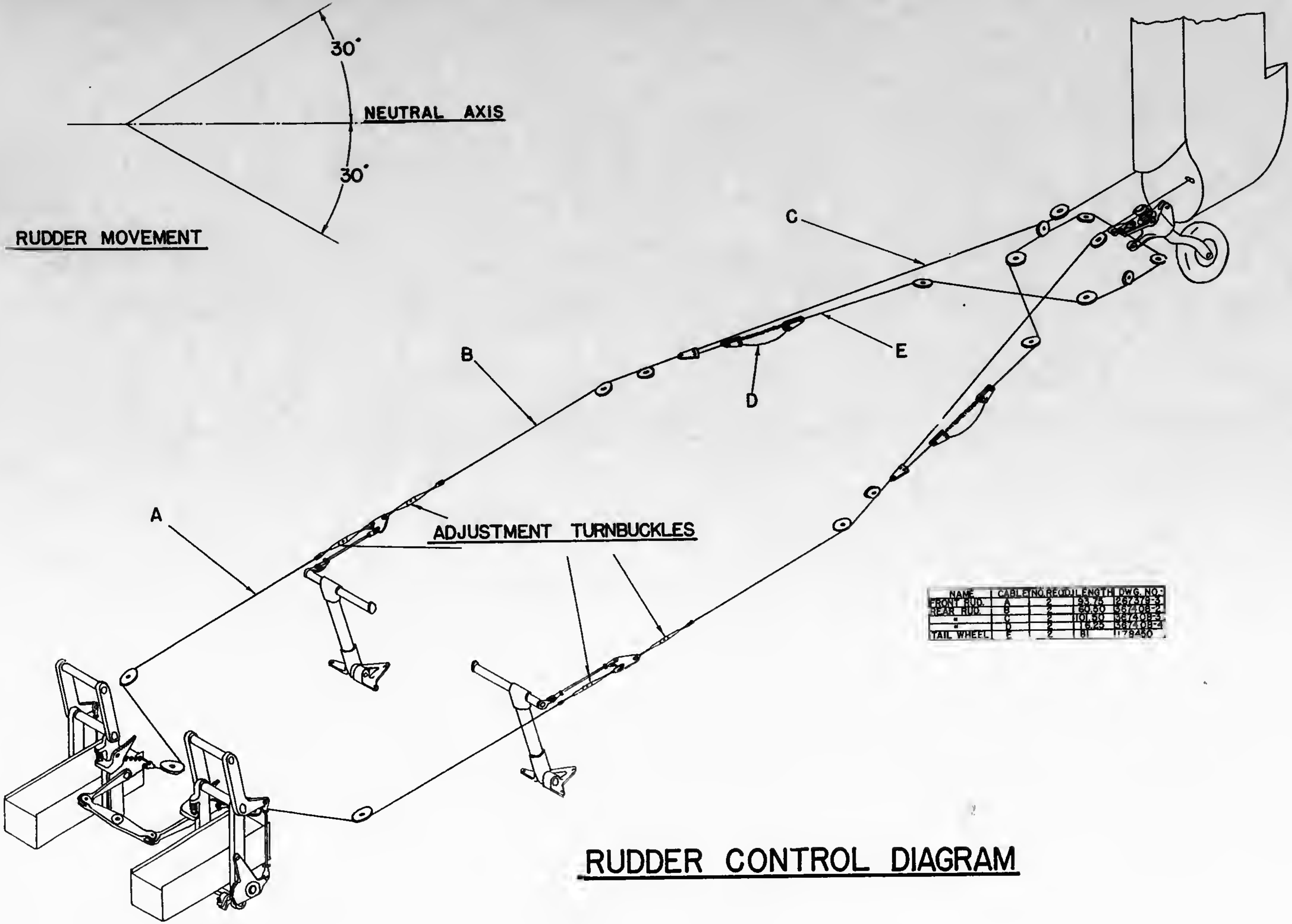
(b) Worn fairleads and connecting bolts.

(c) Cracked or worn pulleys.

(d) Proper tension and adjustment of the cables, see B, NOTE, this section.

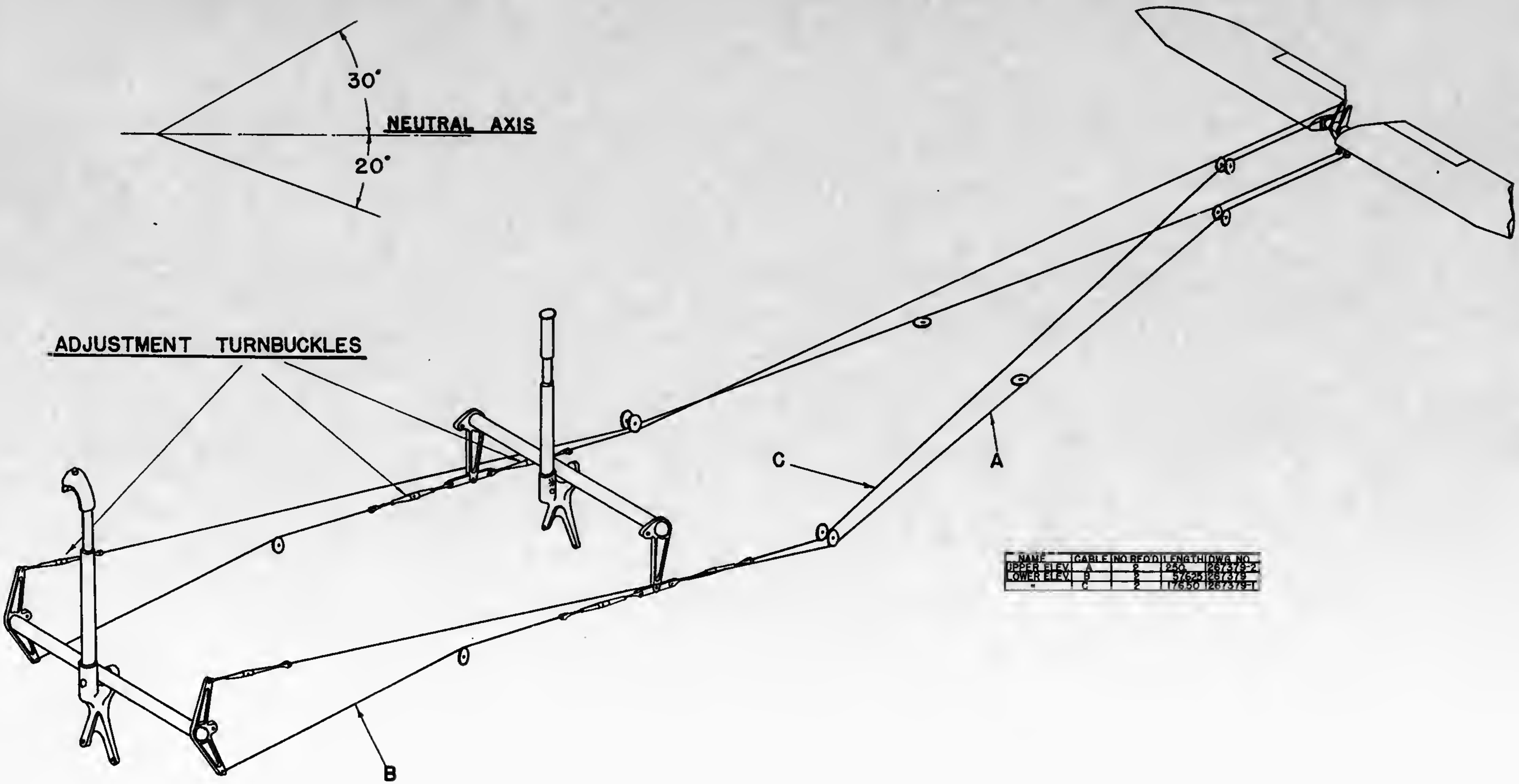
(e) Foreign material near pulley brackets or fair-leads that might jam the system.

2. See Section XXIII for additional maintenance information and page XXIII - 28 for lubrication.



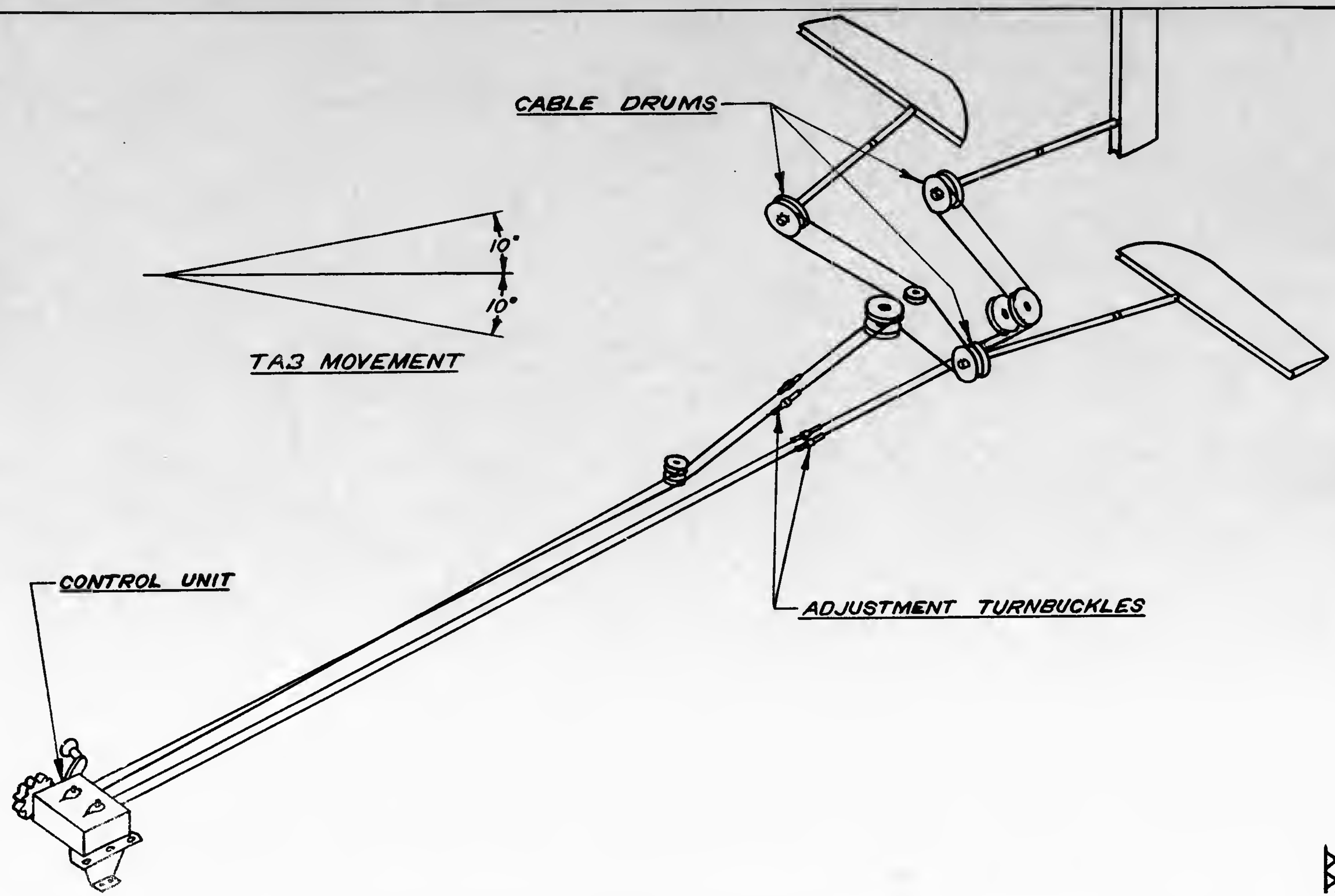
NAME	CABLE	NO. REQ'D	LENGTH	DWG. NO.
FRONT RUD.	A	2	93.75	267379-3
REAR RUD.	B	2	60.50	367408-2
"	C	2	101.50	367408-3
"	D	2	16.25	367408-4
TAIL WHEEL	E	2	81	178450

RUDDER CONTROL DIAGRAM

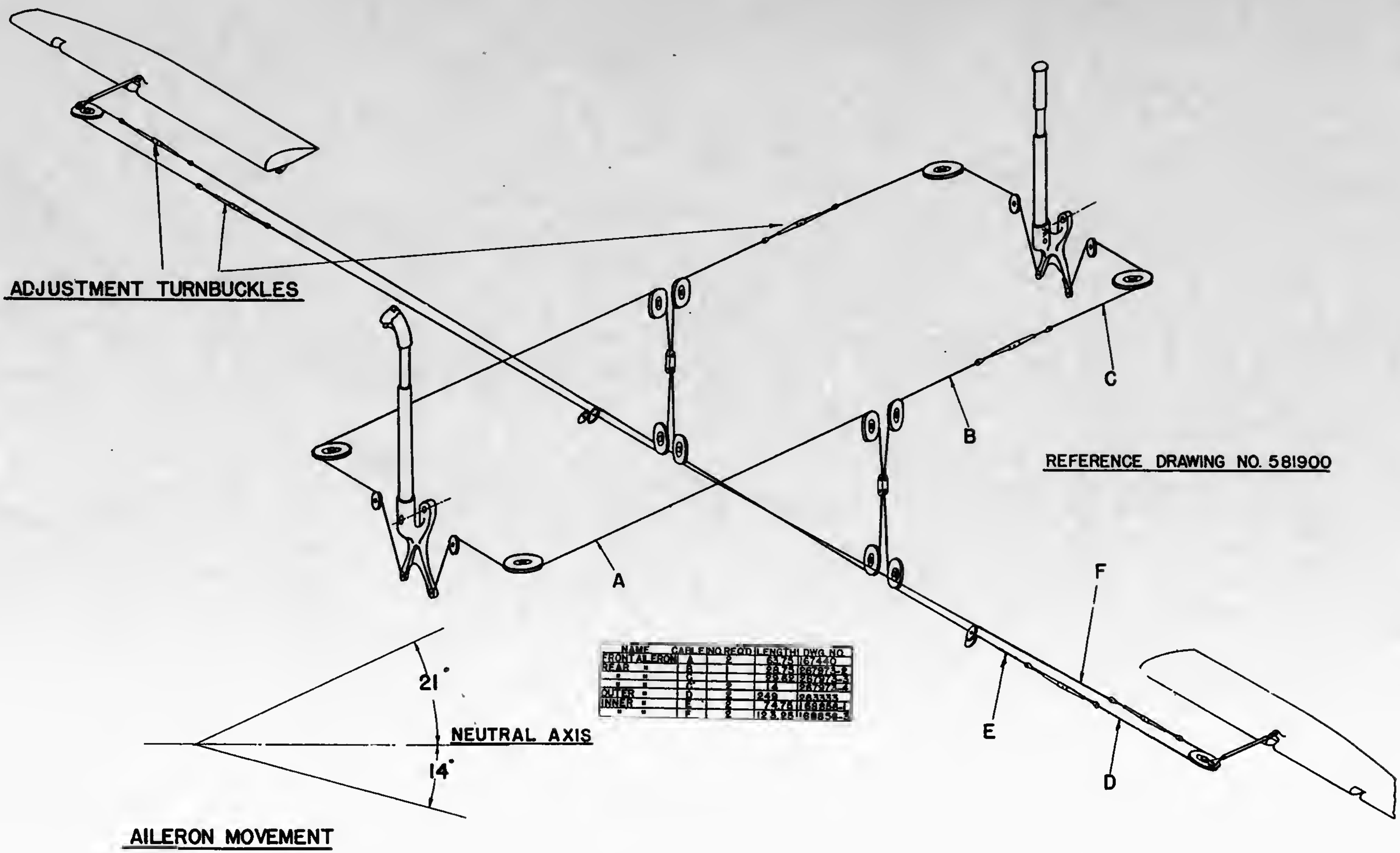


NAME	CABLE	NO REQ'D	LENGTH	DWG NO
UPPER ELEV.	A	2	250	267379-2
LOWER ELEV.	B	2	57625	267379
"	C	2	17650	267379-1

ELEVATOR CONTROL DIAGRAM

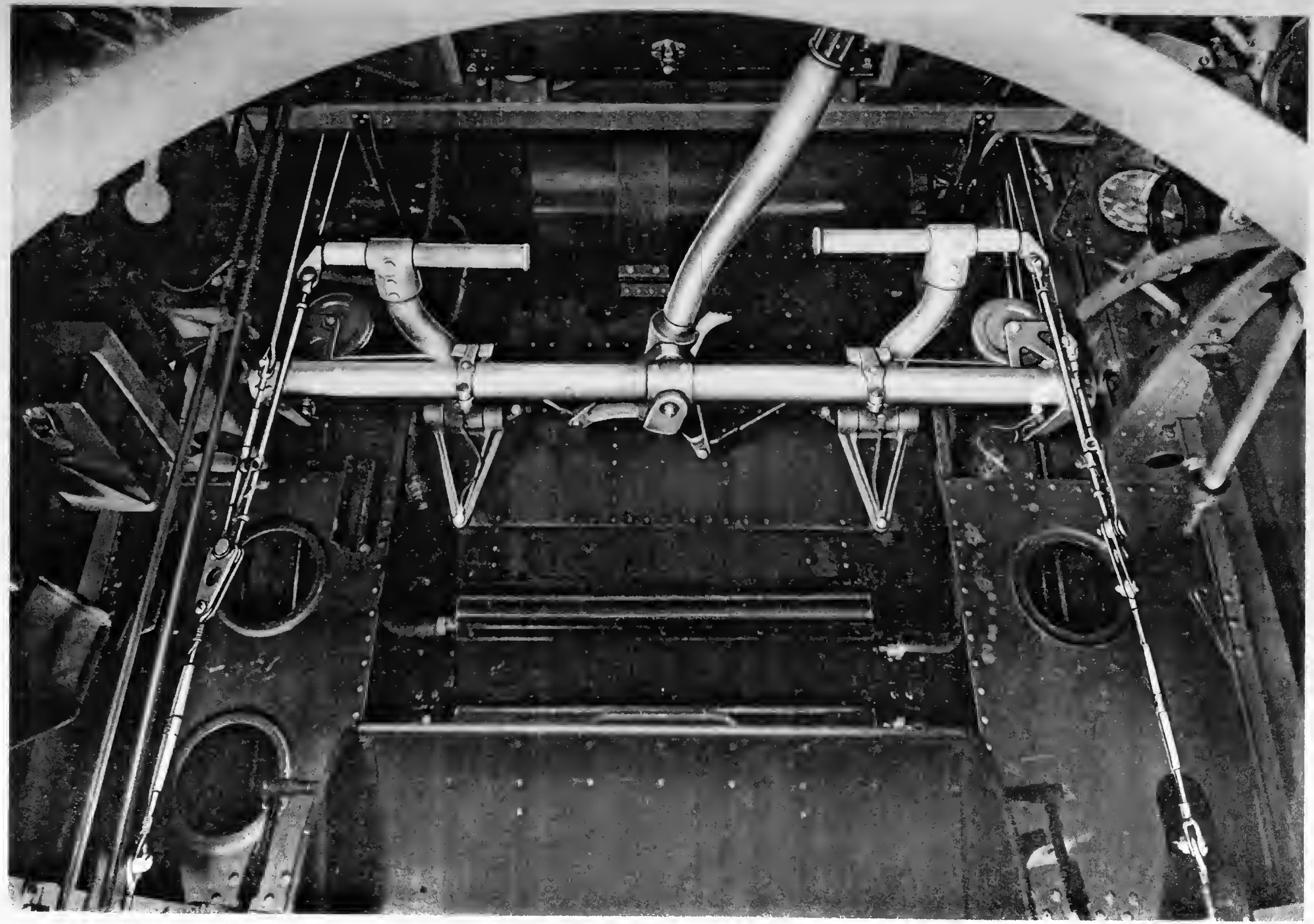


EMPENNAGE TAB CONTROLS

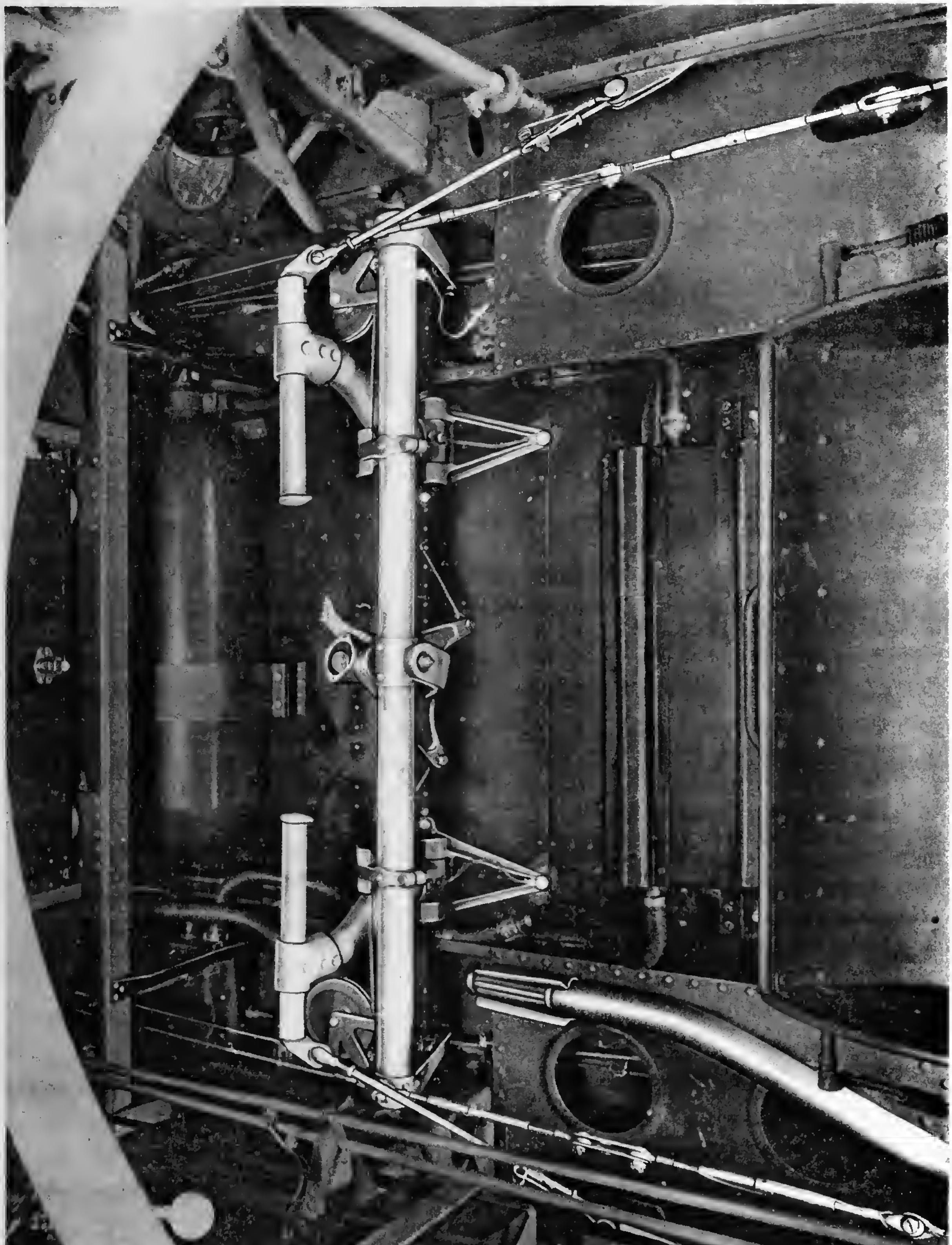


NAME		CABLE	NO. REQ'D	LENGTH	DWG. NO.
FRONT AILERON		A	2	63.75	167440
REAR	"	B	1	28.75	267973-2
"	"	C	1	29.62	267973-3
"	"	C'	2	14	267973-4
OUTER	"	D	2	249	263333
INNER	"	E	2	74.76	169854-1
"	"	F	2	123.25	169854-3

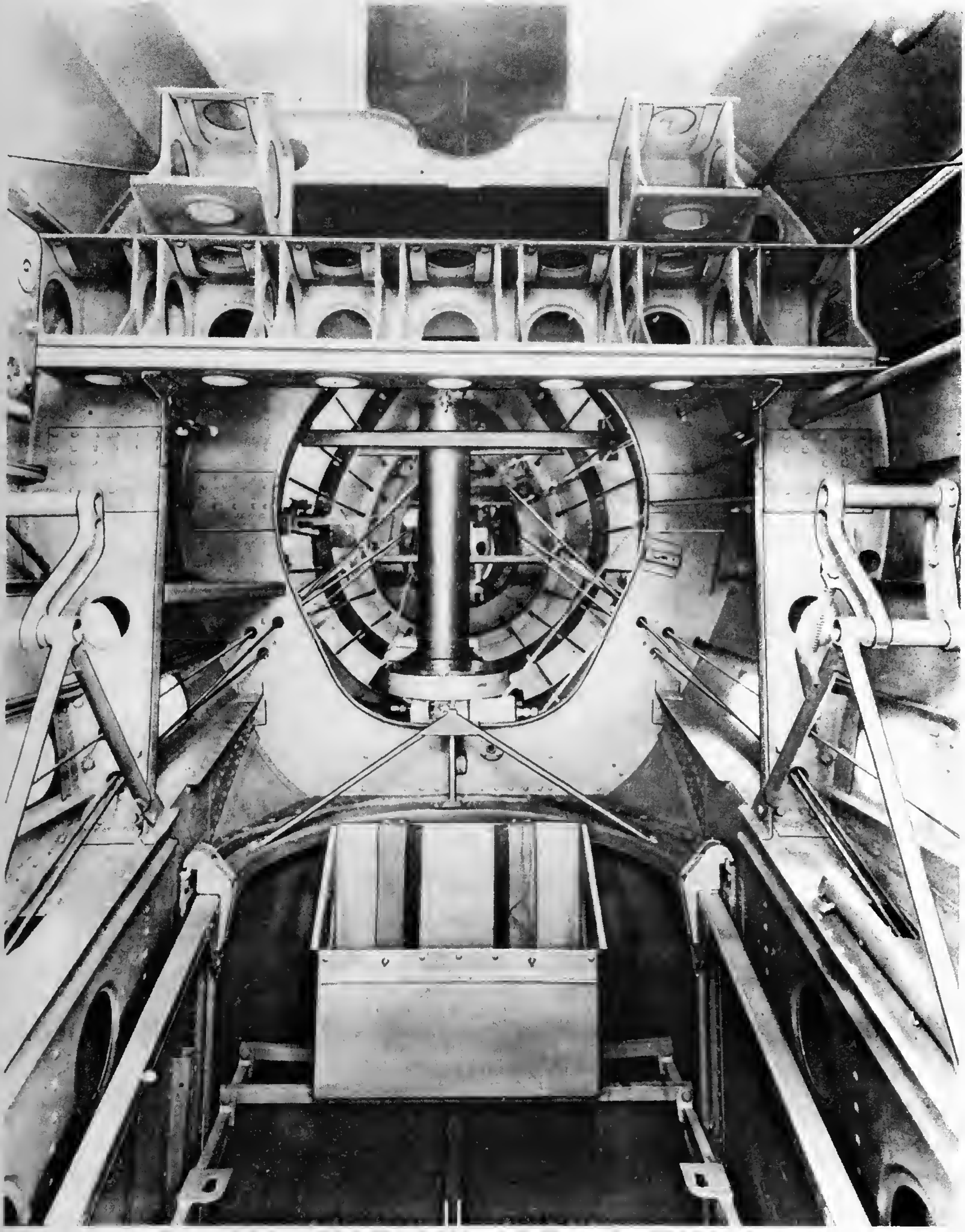
AILERON CONTROL DIAGRAM



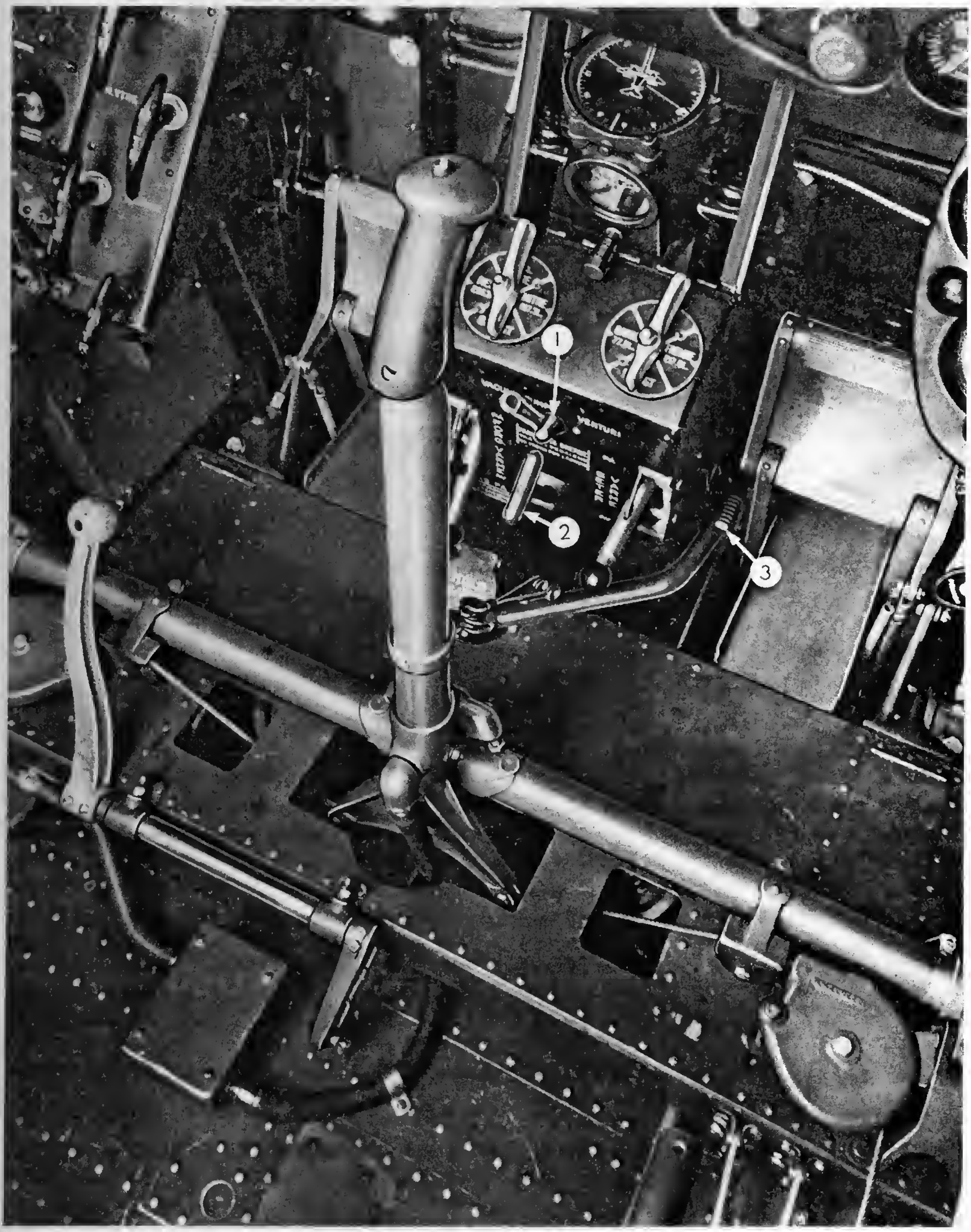
8360 - Flight Controls Installation - Rear Cockpit
Rudder Pedals Locked Operative



8359 - Flight Controls Installation - Rear Cockpit
Rudder Pedals Locked Inoperative

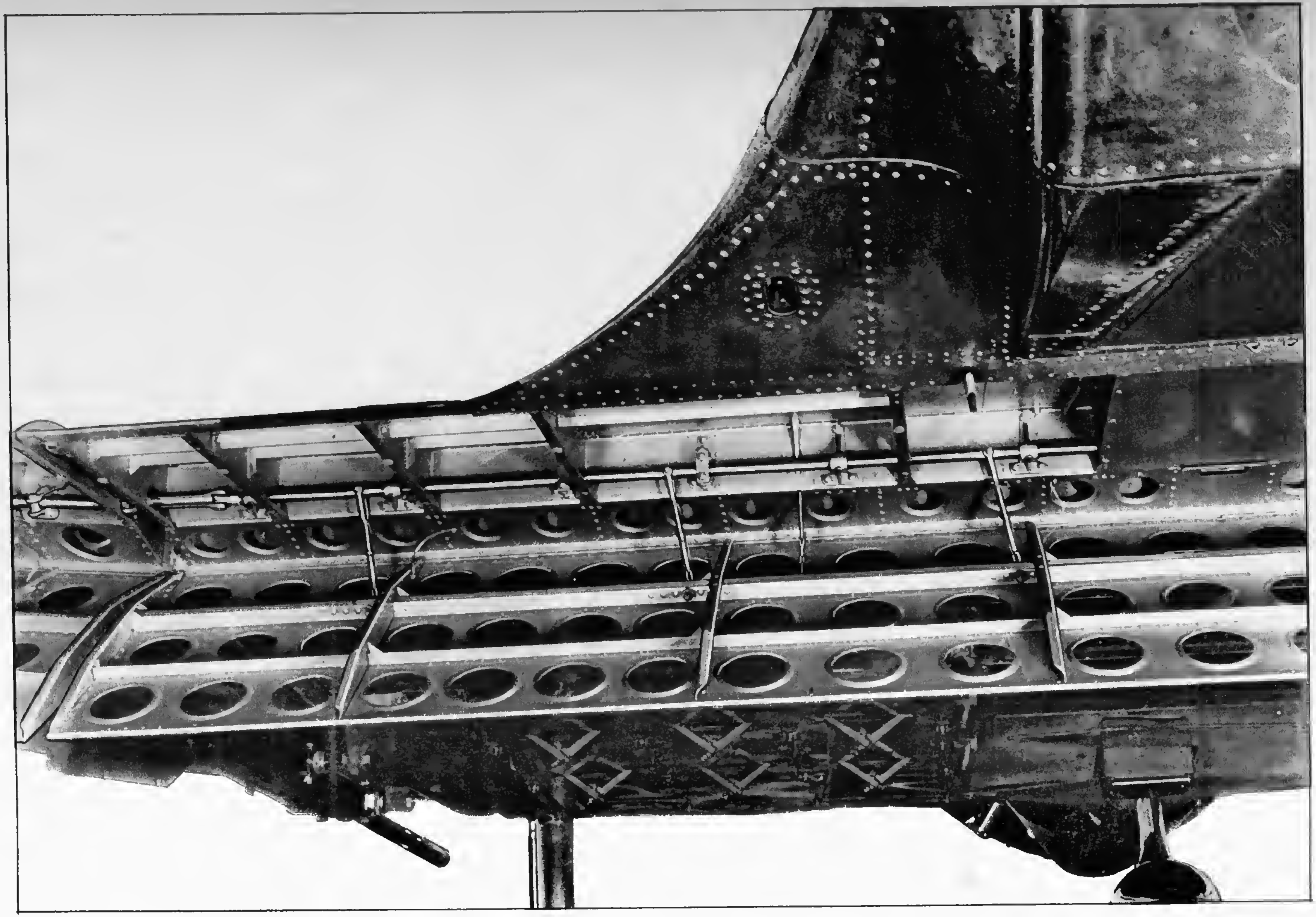


8368 - Flight Control Cables - Aft of Rear Cockpit



1. Vacuum & Venturi Selector Valve 2. Parking Brake Handle
3. Rudder Pedal Adjustment

8366 - Flight Controls Installation - Locks in Use - Front Cockpit



8316 - Landing Flaps Actuating Mechanism

SECTION XXI

ELECTRICAL INSTALLATION

A. DESCRIPTION (Refer to Drawing #5091132).

1. The electrical system is a 24 volt, single wire system and consists of wiring conduit and equipment for ignition, generator, starter, instruments, running lights, gun and bomb control, fuel gages, aero mixture indicator, etc.

2. For locations and details of flight instrument panel, auxiliary instrument panel, upper left and lower left switch panels and other information see Section XXII.

3. Supplied with each airplane on this contract is one blueprint of drawing #5092612, Master Wiring Diagram which may be kept in the airplane for use in the field, etc.

4. Junction boxes, connector panels, quick detachable plugs, and other items of electrical equipment are located as follows:

   (a) Conduit - All electric wiring is run in aluminum (2 S 1/2 hard) conduit in order to provide shielding and thus prevent radio interference. All conduit is bonded to the structure at both ends and at intervals of not more than 18 inches (450 mm.) with bonding strip. Structure must be free of protective coating where bonds are attached to insure a good electrical connection.

   (b) Ignition (Magneto) Pull Box - Mounted on left upper side tube of engine mount.

   (c) Booster Coil - Mounted on right side upper tube of engine mount.

   (d) Cannon Plugs - Left forward side of firewall, from top to bottom; ignition, propeller control, starter and generator.

   (e) Generator, Eclipse Type 314, Model 1 - Left rear side of engine accessory drive case. The generator is a 30 volt, 50 ampere type.

   (f) Starter and Starter Shield Box - Rear center section of engine. Starter is Eclipse Type 463, Series 11.

   (g) Engine Section Junction Box - Left lower tube of engine mount.

(h) A Capacitor or Condenser - Used for the purpose of eliminating generator commutator noise, is mounted on the generator.

(i) Prop Relay Junction Box - Left upper side tube of engine mount.

(j) Thermocouple Copper Constantan Gasket Type - Under rear spark plug of cylinder #1. Constantan is an alloy of copper and nickel.

(k) Firewall Junction Box - Center left aft section of firewall. Contains wire connections for equipment to engine section except ignition and propeller circuits.

(l) Ignition Junction Box - Upper left side of firewall. Contains wire connections to engine section.

(m) Generator Control Box Eclipse Type 667, Model 2 - Upper left side of firewall. Functions in control of generator, regulates voltage and limits current of generator.

(n) Instrument Panel Junction Box - Top of fuselage, forward of instrument panel. Contains wire connections for all electrical instruments and instrument panel lights.

(o) Fuel Gage Junction Box - Under pilot's floor on centerline of airplane, one each aft of frames #3 and #4. Contains wire connection from fuel measuring units.

(p) Fuel Gage Switch Box - Right rear side of engine instrument panel.

(q) Gun Switch Panel - Left side of pilot's cockpit just below instrument panel.

(r) Switch Box Assembly - Left side of pilot's cockpit forward of frame #3.

(s) Ignition Switch - Below gun switch box assembly, left of gun charging handles.

(t) Web #1 Junction Box - Aft of right wing web #1 approximately at right center section fillet.

(u) Control Stick and Bomb Indicator Junction Box - on floor under pilot's seat, aft of frame #3.

(v) Fillet Junction or Main Distribution Box - Between frames #6 and #7, approximately 28 inches (710 mm) forward from trailing edge of left side center section and accessible through door on outside of fuselage. Houses relays for guns, bombs and master battery switch. Distributes wires to both wings.

(w) Fuse Box Assembly - Left side of fuselage between frames #2 and #3.

(x) Gunner's Signal Panel - Upper left side of fuselage, aft of frame #9.

(y) Tail Light Junction Box - Forward side of frame #14 1/2, upper right side.

(z) Tail Light Assembly Box - On vertical stabilizer just forward of rudder.

(aa) Wing Junction Boxes - On rear face of web #5 at bulkhead #1, right and left center section. Houses disconnecting plug for wings.

(bb) Wing Gun Junction Box - Between webs #2 and #3 on bulkhead #2.

(cc) Landing Light Junction Box - On top cover sheet between webs #4 and #5 and between bulkheads #4 and #5.

(dd) Wing Tip Attachment Junction Box - On top skin of wing aft of web #4 and just inboard of the wing tip.

(ee) Navigation Light Junction Box - In the wing tip about 10 inches (254 mm) inboard and at the maximum section.

(ff) Switch, Throttle - On left side of fuselage, aft of frame #3.

(gg) Battery, Exide Type TAS-13 24 Volt - Rear cockpit under the gunner's seat, provides a seat for the gunner when using the view finder or bomb sight.

(hh) Intervalometer Box - Right side of fuselage between frames #9 and #10. Box houses connections for bomb sight, camera view finder, bomb release switch and pilot director.

(ii) Master Switch - Left side of pilot's seat between frames #6 and #7, for control of electric current between the battery and electric system of the airplane.

(jj) Aero Mixture Indicator - The cell, on forward left side of firewall, is electrically connected to the indicator mounted on the instrument panel.

(kk) Horn, Warning Signal - On left side of fuselage forward of frame #2.

(ll) Pilot's Cockpit Light Boxes - One on left side of fuselage forward of frame #3, and one on right side of fuselage between frames #3 and #4.

(mm) Propeller Control Box Assembly - On left side just forward of frame #4.

(nn) Gunner's Cockpit Lights, Two - One on left side and one on right side of "U" stiffener beneath the deck of the fixed enclosure, just forward of frame #7.

(oo) External Bomb Switch Boxes, Eight - Four in left center section aft of web #2 and four in right center section aft of web #2.

(pp) Landing Gear Junction Box - Right side of fuselage forward of web #2.

(qq) Landing Gear Warning Switch, Two - One in left and one in right center section, both attached to forward side of web #2.

(rr) Internal Bomb Rack Junction Box - On right side of fuselage forward of frame #6.

(ss) Leach Relay - In Fillet Junction Box (see "v"), in fairing left wing between frames #6 and #7.

(tt) Ground Battery Plug - Beneath left center section fillet aft of frame #8. A Battery Cart can be connected to the airplane electric system by inserting the cable assembly (furnished for each airplane) into the recessed battery plug.

> NOTE: The Master Switch must be in the "OFF" position when this connection is made in order to avoid drawing current from the airplane battery for starting purposes.

(uu) Switch Cord for Bomber, One - Is wrapped around the Intervalometer Box right side of fuselage between frames #9 and #10, and about 16 inches (400 mm) down from edge of cockpit.

(vv) Radio Junction Box - Located on deck between front and rear cockpits directly above power supply and modulator unit. Contains wire connections for all radio equipment.

5. Junction boxes and connector panels are accessible through cover plates in the fuselage; center section and wing panels.

6. Each wire has a number stamped on a band of adhesive tape near each end.

7. The airplane is completely shielded and bonded for radio.

B. INSTALLATION

1. The following is a list of operations to be performed upon assembly of a new airplane:

(a) The engine section forward of the firewall is considered as one unit. The Cannon plugs to be assembled are, from top to bottom: Ignition, Prop Control, Starter and Generator.

(b) In each wing is a Cannon plug, and receptacle in the center section. Plugging in these connections completes circuits to the wings.

(c) On assembly of the vertical stabilizer, attach the conduit to the junction box on forward side of frame #14 1/2 at terminal #1.

(d) On assembly of the horizontal stabilizer attach the conduit to the junction box on forward side of frame #14 1/2 at terminal #1, (the same junction box to which vertical stabilizer conduit is attached).

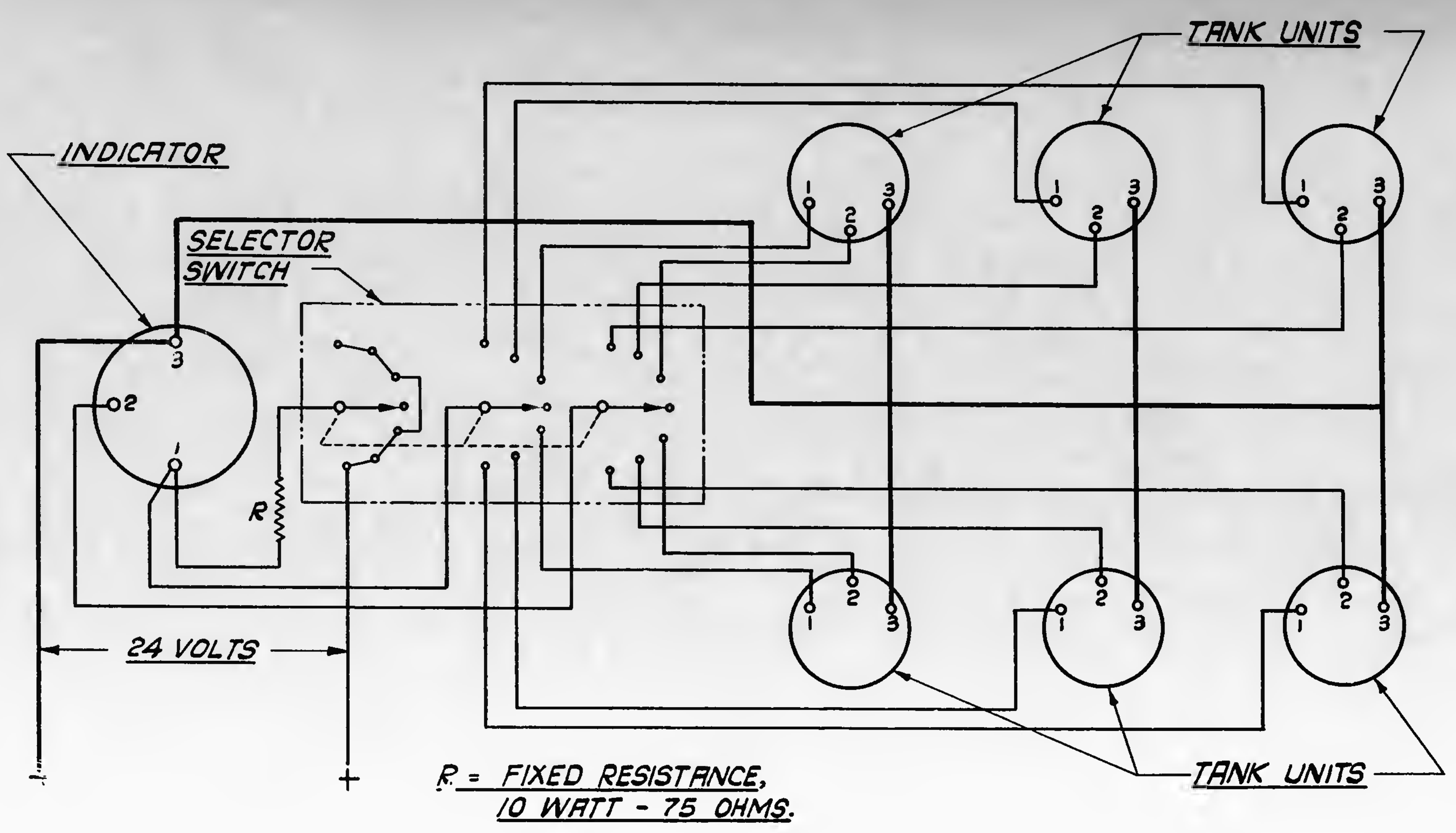
C. MAINTENANCE

1. (a) Check the battery every week and if necessary add distilled water to the cells.

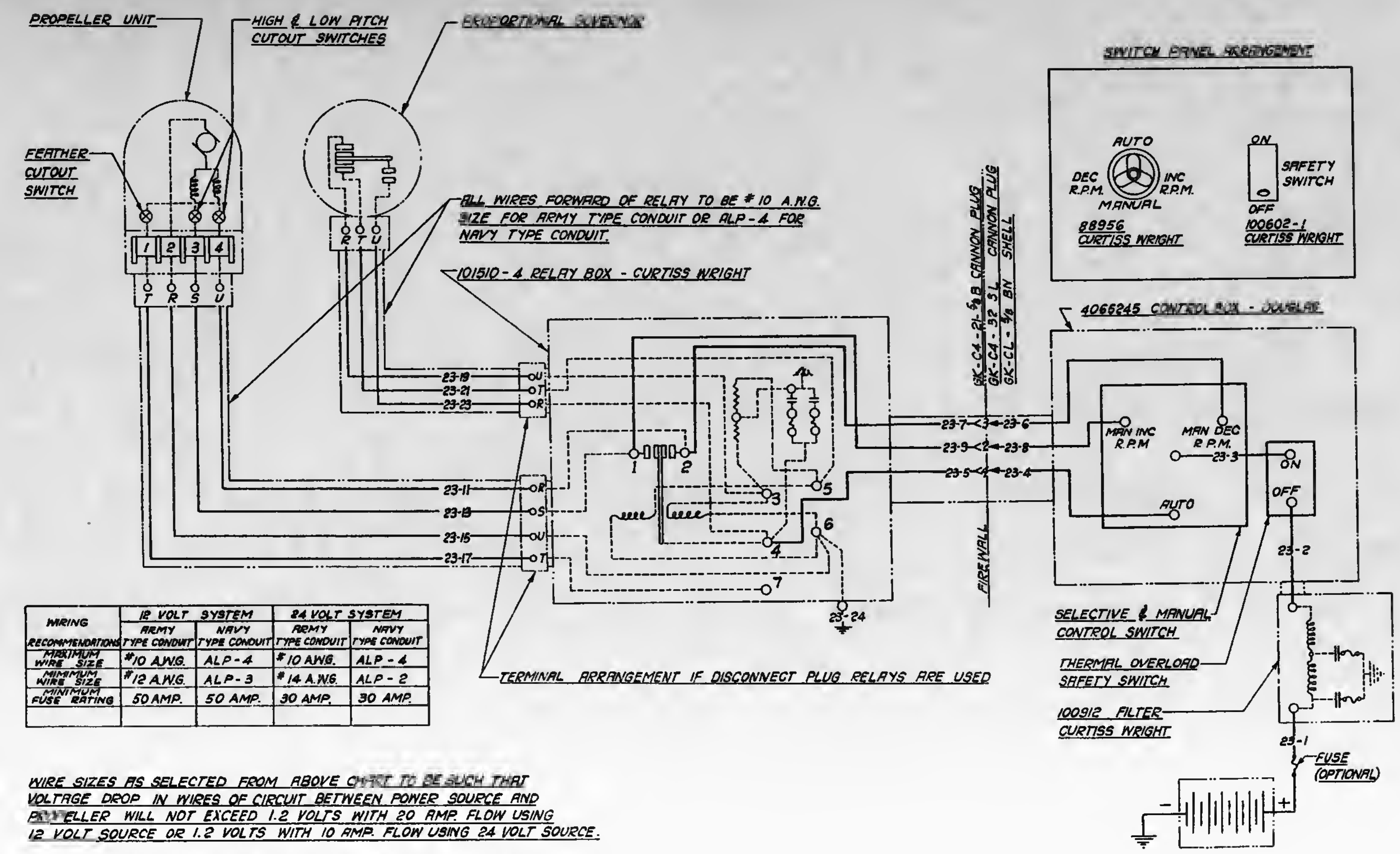
(b) Inspect daily and scrape or brush off any accumulated corrosion from the battery and terminals. Apply a light coat of petrolatum to the cleaned surfaces, bolts, studs, etc. Tighten all terminals and wipe off surplus grease.

(c) To maintain batteries in a healthy state of charge: Add water at regular intervals, keep outside surfaces clean, keep record of check-up, keep battery fully charged.

2. See Section XXIII for further maintenance information and Manufacturer's Book of Instructions for maintenance of battery.



WIRING DIAGRAM
FOR
FUEL QUANTITY GAGE
MODEL 8A-5



WIRING RECOMMENDATIONS	12 VOLT SYSTEM ARMY TYPE CONDUIT	12 VOLT SYSTEM NAVY TYPE CONDUIT	24 VOLT SYSTEM ARMY TYPE CONDUIT	24 VOLT SYSTEM NAVY TYPE CONDUIT
MAXIMUM WIRE SIZE	#10 A.W.G.	ALP-4	#10 A.W.G.	ALP-4
MINIMUM WIRE SIZE	#12 A.W.G.	ALP-3	#14 A.W.G.	ALP-2
MINIMUM FUSE RATING	50 AMP.	50 AMP.	30 AMP.	30 AMP.

WIRE SIZES AS SELECTED FROM ABOVE CHART TO BE SUCH THAT VOLTAGE DROP IN WIRES OF CIRCUIT BETWEEN POWER SOURCE AND PROPELLER WILL NOT EXCEED 1.2 VOLTS WITH 20 AMP. FLOW USING 12 VOLT SOURCE OR 1.2 VOLTS WITH 10 AMP. FLOW USING 24 VOLT SOURCE.

ALL PROPELLER WIRES TO BE LOCATED IN SEPARATE CONDUITS EXCLUDING ALL OTHER WIRES

WIRING DIAGRAM SHOWS TERMINAL CONNECTIONS. SWITCH PANEL ARRANGEMENT SHOWS SWITCH PANEL MARKINGS AND DIRECTION OF THROW OF TOGGLES.

THIS DIAGRAM FOR RIGHT HAND ROTATION PROPELLER

PROPELLER WIRING

TRACED FROM CURTISS WRIGHT DWG #102918 (PROPELLER DIVISION)

RADIO

A DESCRIPTION & FUNCTION

The radio equipment on this airplane comprises the follow ing units which are arranged to function as follows:

1. FRONT COCKPIT

(a) Automatic Radio Compass direction finder.

(1) Pilot's control panel (Lear Model ADF - 7)

(2) Lear-matic Indicator

(b) Communications equipment. The pilot may also use the equipment listed in B, 1, following, for radio communications (either sending or receiving)

2. REAR COCKPIT

The rear cockpit units comprise the following:

(a) Radio communications equipment.

(1) Receiver and transmitter control unit

(2) Transmitters (100 watt).

(3) Power supply and modulator.

(4) Radio junction box.

(b) Automatic radio compass direction finding equipment.

(1) Loop Azimuth Indicator.

(2) Intermediate frequency unit.

3. ANTENNA SYSTEMS

(a) Radio compass loop. Located beneath center section wing.

(b) Radio compass sense antenna. Extends from mast to vertical stabilizer.

(c) Trailing antenna (communications) electrically operated. Extends from reel through fairlead in bottom of fuselage between frames #12 and #13.

(d) Fixed antenna (communications). Extends from inboard of right wing tip to vertical stabilizer.

B. <u>OPERATION</u>

1. <u>General</u>

The ADF-7 automatic direction finder may be operated only by the pilot through the pilot's control panel. The automatic direction finder receiver may be switched to function as:

(a) Conventional communications receiver.

(b) Communications receiver using the loop antenna for anti-static reception.

(c) Automatic radio direction finder.

2. <u>Pilot's Controls</u>

(a) The pilot may exert some control of the remainder of the radio equipment by means of switches and jacks at his command and by directions, via the interphone, to the operator in the rear cockpit.

(b) The pilot may switch his headset to hear either the communications receiver or the automatic direction finder. His headset is always connected to the interphone circuit, regardless of which receiver he is listening to. Side tone is furnished so that the pilot hears his voice in his headset when he speaks into the microphone. The pilot's microphone may be switched to select either the interphone or the radio transmitter.

3. To operate the transmitter the pilot must first instruct the operator in rear cockpit as follows:

(a) Turn on master switch for transmitter

(b) Tune the proper transmitter to the desired frequency.

(c) Adjust the switch to select the desired type of emission, i.e radio telephone, continuous wave (C.W.) or modulated continuous wave (M.C.W.).

4. The pilot may then operate the transmitter using either the key or microphone, according to which type of emission the transmitter has been adjusted to give The pilot should then use the ADF-7 as the communication receiver, but may instruct the rear cockpit operator to adjust the communications receiver to the proper frequency, so that the pilot can listen to it on his headset and will not

have to interrupt the operation of the ADF-7 unit. The push-to-talk button on the microphone controls the power to the transmitter for radio phone, and the key controls the power for C.W. or M.C.W.

5. Control By Rear Cockpit Operator

(a) Operator's headset is always connected to the interphone circuit and may be switched to either the ADF-7 unit or the communications receiver. Operator also has a microphone for use with either the interphone or transmitter for radio phone. Operator's telegraph key operates the transmitter for C.W. or M.C.W. Operator may also:

(1) Select the antenna to be used, and control the trailing antenna.

(2) Tune the proper transmitter to desired frequency.

(3) Select the type of emission.

(4) Control the transmitter master switch.

(5) Operate and tune the communications receiver.

(6) Observe the azimuth indicator which indicates the true bearing of the radio compass loop axis.

6. Fuel Unit Inspection Door

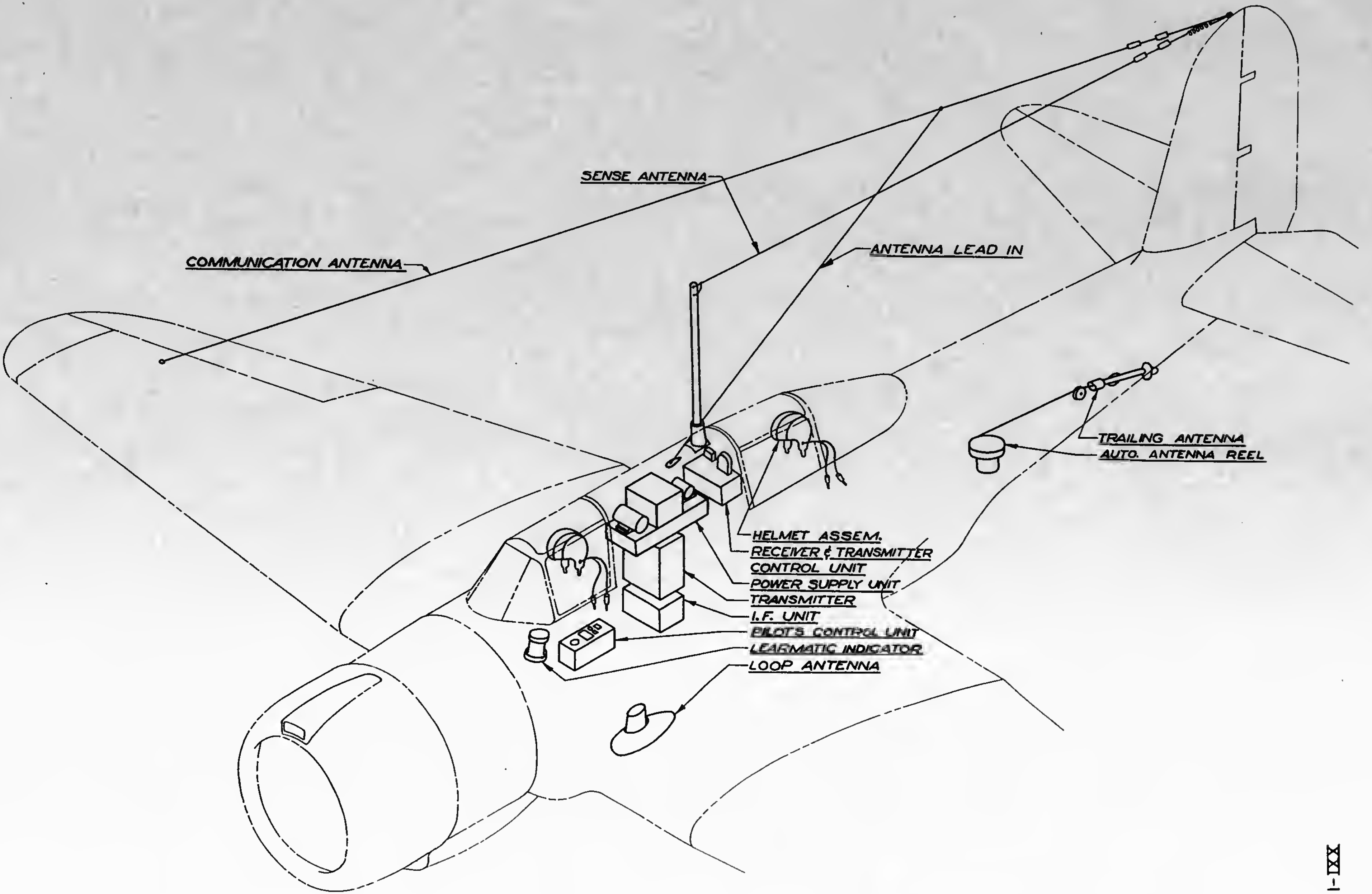
(a) Part #2059299 - "Door Assem. - Fuel Unit Inspection" is shipped as a loose part of the airplane. This part is to be used when Part #5093371 - "Center Section Loop Fairing" and the Radio Compass Loop Antenna is not installed on the airplane. Part #5095884 - "Fuel Unit Inspection Small Door Assem." is furnished installed on the airplane and should be used when the "Center Section Loop Fairing" and the Radio Compass Loop Antenna is installed on the airplane.

(b) These two parts may be interchanged by removing the hinge pin from the door hinge, substituting doors and replacing the hinge pin.

C. MAINTENANCE

1. For detailed operating, maintenance and service instructions, see Instruction Book, Lear-Avia, Inc.

2. For installation information and locations of the radio equipment, refer to Douglas Drawing #5091133 and Isometric Drawing on page XXI - 11.



RADIO INSTALLATION

8358 - Radio Installation - Rear Cockpit

SECTION XXII

AERONAUTICAL INSTRUMENTS

A. DESCRIPTION (Refer to Drawing #5091136)

FRONT COCKPIT

1. The instrument and switch panel units in the pilot's cockpit are divided into five panels:

    Flight Instrument Panel

    Engine Instrument Panel

    Auxiliary Instrument Panel

    Left Upper Switch Panel

    Left Lower Switch Panel

2. Flight Instrument Panel, located on centerline of the pilot's cockpit, forward of seat, mounts the following instruments:

(a)	1	Airspeed Indicator	Pioneer	1402-9M
(b)	1	Bank & Turn Indicator	Pioneer	1700-1AC
(c)	1	Rate of Climb Indicator	Pioneer	1610-2N
(d)	1	Sensitive Altimeter	Pioneer	1524-3U
(e)	1	Magnetic Compass	Pioneer	1820-1
(f)	1	Suction Gage	Pioneer	2601-2E
(g)	1	Artificial Horizon	Sperry	645720
(h)	1	Aero Mixture Indicator	Cambridge	S-IF-A

3. Engine Instrument Panel, located aft of frame #2 in pilot's cockpit below and to the right side of flight instrument panel, mounts the following instruments:

(a)	1	Engine Cylinder Temperature Indicator	Lewis	17AT-3S
(b)	1	Tachometer	Pioneer	2000-2J
(c)	1	Manifold Pressure Gage	Pioneer	1911-2R

(d)	1	Fuel Quantity Gage	Motometer	7684-A
(e)	1	Carburetor Air Thermometer	M.M.M.	6645-46
(f)	1	Engine Gage Unit (Fuel Pressure, Oil Pressure & Oil Temperature)	M.M.M.	6546-57

4. Auxiliary Instrument Panel, located on frame #3 on the right side of pilot's cockpit, mounts the following instruments:

(a)	1	Clock	Pioneer	3310-2
(b)	1	Outside Air Thermometer	M.M.M.	6648-45

5. Left Upper Switch Panel, located left side of cockpit aft of frame #2, mounts the following instruments:

(a)	1	Switch, .30 Caliber Guns Selector 80 Amp.	Briggs & Stratton	26B-3964
(b)	2	Switches, .50 Caliber Guns Selector 20 Amp. each	Cutler - Hammer	8201
(c)	1	Rheostat, Gyro Lights 90 Ohm	Spec. #32008 & 9	
(d)	1	Rheostat, Center Panel 80 Ohm	Spec #32008 & 9	
(e)	1	Rheostat, Right Panel 150 Ohm	Spec #32008 & 9	
(f)	1	Switch, Bomb Safety		AN-3015
(g)	1	Switch, Bomb Selector		AN-3014
(h)	1	Plate, Bomb Indicator Lights		4066048

6. Left Lower Switch Panel, located on left side of cockpit, below upper switch panel, mounts the following instruments:

(a)	1	Rheostat, Formation Lights 32 Ohm	Spec. 32008 & 32032	
(b)	1	Switch, Pitot Heater		AN-3015

(c) 2 Switches, Landing Lights AN-3015

(d) 1 Switch, Blinker AN-3016

(e) 1 Switch, Navigation Lights AN-3017

7. Pitot Tube, located on leading edge of left wing inboard of wing tip.

8. Venturi, located forward of frame #2 above horizontal centerline of airplane attached to outer surface of fuselage. Acts as auxiliary in the event suction pump becomes inoperative.

9. Fuel Pressure Warning Switch, Pioneer 3110, is located on aft side of firewall. The light which is actuated by this switch, is on the Flight Instrument Panel. If the fuel pressure is lower than .42 -- .49 kgs./cm^2 the switch will make contact illuminating the red jewel light on the panel.

10. Pilot Director, (Furnished with Bomb Sight and used in conjunction therewith). This instrument indicates the direction in which the bomber desires the pilot to fly. It is located on a small bracket just below the Engine Instrument Panel on right side of cockpit.

11. Hydraulic Pressure Gage, mounted on same bracket as Pilot Director below the Engine Instrument Panel.

12 Engine Magneto Ignition Switch, is mounted separately on left side of cockpit just below the Upper Switch Panel. (Briggs & Stratton, AC 31-197)

13. Lear-matic Indicator, which is an automatic flight direction indicator is located directly in front of pilot's seat, above the control pedestal. Switch is located on Radio Compass and Transmitter control panel, right side of cockpit.

14. Engine Cylinder Temperature Indicator, mounted on the Engine Instrument Panel is a sensitive mechanism in the form of a couple, one wire being iron the other being constantan. (Constantan is an allcy of copper and nickel).

REAR COCKPIT

15. Flight Instrument Panel, located on forward side of frame #7, right side of cockpit, mounts the following instruments:

(a) 1 Sensitive Altimeter Pioneer 1524-3U

(b) 1 Airspeed Indicator Pioneer 1402-9M

16. Ignition Switch, remote control. See page XIV-4.

17. Magnetic Compass, Pioneer 1820-1, is located on the right side of the deck of the fixed enclosure, at frame #7.

18. Signal Panel, Gunner's with Blinker Switch is mounted on the left side of fuselage, between frames #9 and #10.

19. Receiving and Transmitting Control Panel, Lear-Avia Radio, is located on the deck of the fixed enclosure This panel controls radio compass and radio transmitting except transmission tuning.

20. Azimuth Indicator, located upper part of fixed enclosure above control panel. It indicates position of loop antenna.

21. Radio Transmitter Unit, Lear-Avia, is located on the right side of the cockpit.

B. INSTALLATION

1. There are no special installation operations to be performed on the instrument equipment incident to the erection of a new airplane except making the connections indicated in Section XXI, B, and the connection of the pitot-static lines, in left wing only. Section IV, B.

2. Aero Mixture Indicator. The following flow test of the Aero Mixture Indicator installation should be made when engine change is accomplished; any change of exhaust collector ring or tailpipe; or at any time a flow test is deemed necessary Procedure:

(a) Disconnect the lines at the analysis cell, located on aft side of firewall and attach about 15 feet (4.5 m.) of 3/8 inch (9.5 mm.) tubing to each line, bringing the free ends of the tubing outside the propeller slip stream.

(b) Connect the tubes to a manometer which will register about 8 inches (200 mm.) of water

(c) Run the engine from 1000 to 1200 r.p.m. and see that the pressure drop, as registered by the manometer, is at least 1/4 inch (6 mm.) to 4 inches (100 mm.) of water.

(d) Run the engine at full allowable r.p.m. on the ground, and see that the manometer registers not more than 4.3 inches (109 mm.) of water. If the pressure exceeds this amount, the intake nipple (located lower right side of collector ring) should be rotated a few degrees away from the direction of the exhaust blast and the pressure again checked.

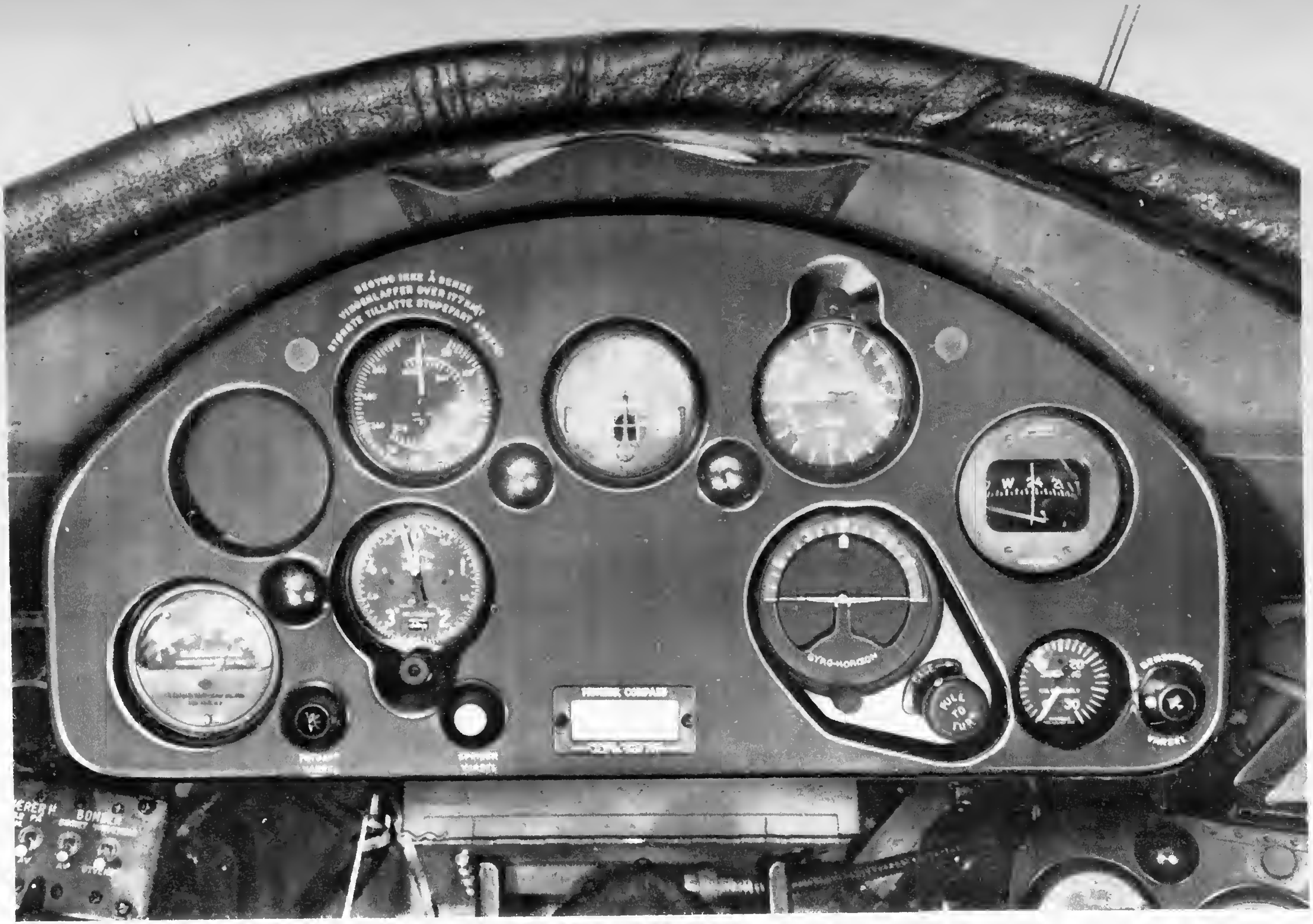
(e) Repeat this procedure until the pressure indicated is within the limits specified in (c).

(f) Disconnect the manometer tubes and reconnect the lines at the analysis cell, making sure that the pressure line is connected to the "IN" port of the cell.

(g) Test the analysis cell tube connections by coating them with soapy water and watching for formation of bubbles. For this test, attach a low pressure (approximately 3.5 lbs. per. sq. in.-.24 kgs/cm^2.) air hose to the intake (upper) sampling nipple in the lower right side of collector ring. The appearance of bubbles indicates that carbon-monoxide gas will escape from the tubes and endanger the pilot. Tube connections must be tight.

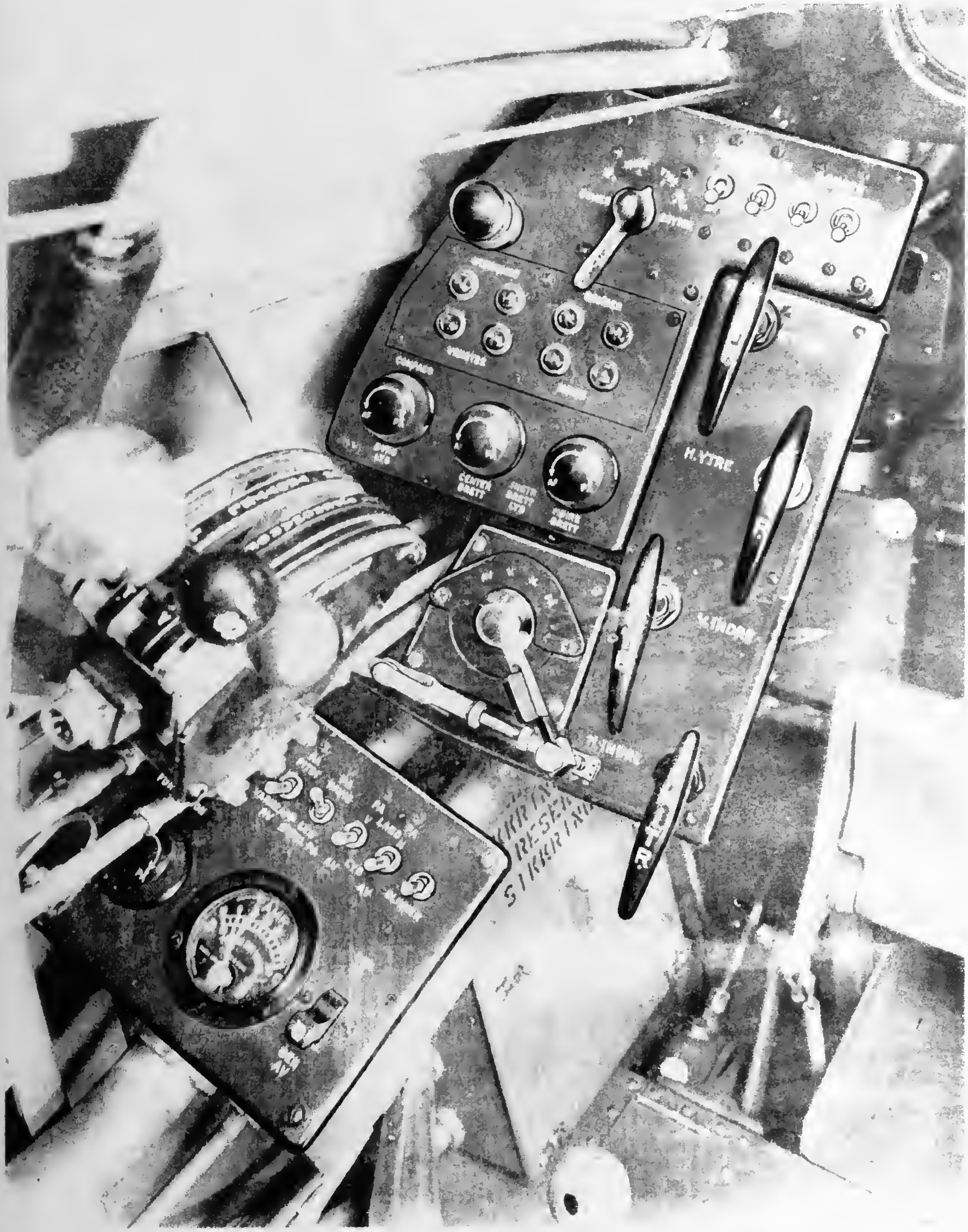
C. MAINTENANCE

1. Check the operation of each engine instrument before each flight and during warm-up.
2. Check all instruments for cracked crystals, loose mounting bolts, and cracked or broken cases.
3. For further information concerning each instrument, consult literature published by the instrument manufacturers.
4. See Section XXIII for additional maintenance information.



8367 - Flight Instrument Panel - Front Cockpit

8361 - Engine Instrument Panel



8370 - Electrical Control Panels

SECTION XXIII

INSPECTION & MAINTENANCE

A. INSPECTION TABLE

NOTE: Reference page numbers used in this table indicate the page number in this section only.

	Pre-flight	Daily	20 Hr	40 Hr	100 Hr
Aero Mixture Indicator	5			26	
Ailerons		9	19		
Airspeed Indicator	5				
Altimeter	7				
Ammeter - Volt	5				
Battery Box				25	
Battery (Weekly) pg. 12					
Bomber's Compartment	6		16	24	
Brakes		10			
Cables - Control			17		
Carburetor		8	14	21	26
Charts, Lubrication		28&29	28&29	28&29	28&29
Clock	6				
Compartment, Bomber's	6		16	24	
Compass				23	27
Cockpits	6	9	15		
Control Stick			17		
Controls - Engine		7	13		
Controls - Flight		9	16		
Control Surfaces		9	19		
Cowling - Engine		8		23	
Cylinder Temp Indicator	5				
Door - Gun Tunnel			16		
Electrical		7	13	21	
Elevators		9	19		
Empennage		10		24	
Enclosures	7	9	15		
Engine		8	15	22	26
Engine Change			25		
Engine Controls		7	13		
Engine Cowling		8		23	
Engine Instruments		7			
Engine Mount		7		23	
Engine Temp Indicator	5				
Equip. - Night Flying	7	11		25	
Extinguisher - Fire	4	11			27

	Pre-flight	Daily	20 Hr.	40 Hr.	100 Hr.
Filter - Oil		8	14	21	
Fire Extinguisher	4	11			27
Fixed Gun Sights		11		25	
Flap Controls		9	18	23	
Flares & Release Mechanism	7			25	
Flight Control Mechanism		9	16		
Flight Control Stick		9	17		
Flight Control Surfaces		9	19		
Fuel Pressure Gage	5				
Fuel Quantity Gage	6				
Fuel System		8	14	22	26
Fuel Tanks		8	15	21	
Fuselage		11			
Gage - Fuel Pressure	5				
Gage - Fuel Quantity	6				
Gage - Oil Pressure	6				
General Data	4	4			27
Generator	5		12	21	26
Gun Sights - Fixed		11		25	
Gun Tunnel Door			16		
Gunner's Seat		9	15		
Hydr Pump, Eng. Driven	5				
Ignition Switch	4				
Ignition & Electrical		7	13	21	
Instruments - Engine	4	7			
Instruments - Navigation	4	9			
Landing Flap Controls		9	18	23	
Landing Gear		10	20	24	
Lights	7				
Lubrication Charts		28&29	28&29	28&29	28&29
Magnetos	4				
Magneto Switch	4				
Manifolds			15		
Mixture Indicator, Aero	5			26	
Navigation Instruments	4	9			
Night Flying Equipment	7	11		25	
Oil Pressure Gage	6				
Oil System		8	14	22	
Oil Tank		8	14	21	
Oil Filter		8	14	21	
Pressure Gage - Fuel	5				
Pressure Gage - Oil	6				
Propeller & Accessories	6	8	15		

	Pre-flight	Daily	20 Hr.	40 Hr.	100 Hr.
Pyrotechnics	7	11		25	
Pump - Hydraulic Engine	5				
Quantity Gage - Fuel	6				
Rear Landing Wheel		10	19	24	
Rods - Control			17		
Rudder Pedals			16		
Seats - Pilot's & Gunner's	6	9	15		
Shock Strut		10	20		
Sights - Fixed Gun				25	
Starter			12	21	26
Stick - Control			17		
Surface Controls		9	19		
Switch - Magneto	4				
Tab Controls			17		
Tachometer	6				
Tail Gear		10	19	24	
Tanks - Fuel & Oil		8	15	22	26
Temp. Indicator - Engine	5				
Tires		10			
Vacuum Control Valve	6				
Valve Mechanism, Engine			15	22	
Volt - Ammeter	5				
Wheels & Brakes		10	20	25	
Wings		10		23	27
Wiring - Ignition		7	13	21	

B. GENERAL DATA

1. All zerk fittings are painted brown for ready identification

2. See Pages XXIII - 28 and XXIII - 29, for diagrams showing location of zerk fittings and other points of lubrication.

3. Before assembling aluminum or aluminum alloy threaded parts or any pipe fittings which are to carry fluids, coat the male threads lightly with thread lubricant.

C. PRE-FLIGHT INSPECTION

1. During all ground tests with engine running with exception of the full power test, set the manifold pressure not to exceed 76 cm. Hg. For the full power test adjust the manifold pressure to 115.5 cm. Hg. with the propeller governor control set at 2550 r.p.m. position.

2. Fire Extinguisher, Engine - Observe the inspection window. If cross on indicator is visible, cylinder is empty and should be recharged before airplane is permitted to fly.

3. While warming the engine prior to the first flight of each day, check the following:

   (a) Inspect instruments on all panels for:

      (1) Broken or loose crystals.

      (2) Loose dials or indicators.

      (3) Broken mounting flanges and loose or missing bolts.

      (4) Loose connections.

   (b) Test magneto switch as follows:

      (1) Put the switch momentarily to the "OFF" position. If the engine does not cease firing, impaired functioning of the switch or its connections, probably a defective ground connection, is indicated. Turn the switch first to the left magneto and then to the right. No appreciable difference should be noted in the use of either one or both magnetos.

For these tests, the engine should not be hot and the period during which the switch is in the "OFF" position should be for only an instant, so that the engine r.p.m. is not decreased appreciably. While checking magnetos, listen to and observe smooth running on each magneto rather than to minor and temporary r p.m. drop.

(c) Volt-ammeter:

(1) Ammeter: With the generator line switch "ON" and the engine running at cruising r p.m., note whether or not the ammeter indicates "charge". If it does, the ammeter operation is satisfactory. If not, note whether the pointer appears to move freely or is sticking. If no charge is shown and the pointer appears to move freely, inspect further for maladjustment of generator controls. Before further work is done, consult the technical instructions pertaining to the type of equipment involved.

(2) Voltmeter: With the generator line switch "OFF", press the voltage switch. If the pointer moves freely, is steady and coincides with the line on the scale for the proper voltage setting, the operation is satisfactory. If, with the line switch "ON", the voltage is "ZERO", release the voltage switch and if the ammeter indicates "CHARGE" there may be an open circuit, or the meter itself may be damaged.

(d) Generator Control Box: See that the generator voltage has been adjusted to give 28.9 to 29.1 volts at no load.

(e) Engine Driven Hydraulic Pump: With the engine running at from 600 to 1000 r.p.m., operate the landing flaps by means of the engine driven hydraulic pump to ascertain that the pump and pump engaging valve operate properly.

(f) Air Speed Indicator: Drain the pitot-static tubes. The drain plugs are accessible through a door located in the under side of the left wing just outboard of the center section.

(g) Aero Mixture Indicator: Check the indicator to make certain that its reading correctly follows changes in mixture control. Allow five or six seconds to elapse before taking a reading

(h) Engine Cylinder Temperature Indicator: Note whether or not the indicator shows increased temperatures as the engine is warmed up If increased temperatures are not indicated, it is probable that the instrument is defective, or the connection is broken at the engine

(i) Fuel Pressure Gage: With the engine running at 1000 r.p.m , the gage should indicate a pressure of 840 - 980 Kgs/cm^2 Check for excessive oscillation of the pointer See that the pointer is at "ZERO" when the engine is not running and the fuel valves are in the "OFF" position

(j) Oil Pressure Gage: With the engine idling, the gage should indicate not less that .91 $Kgs./cm^2$ With the engine running at cruising speed, the reading should be 5 5 7 Kgs/cm^2 See that the pointer reads "ZERO" when the engine is not running

(k) Fuel Quantity Gage: Turn the selector switch to each tank to check the indicators functioning If the approximate quantity of fuel in the tanks is known, as would be the case if the tanks had just been filled, check the gage reading for each tank

(l) Tachometer: With the engine running, observe the pointer for steady movement at all engine speeds; it should not oscillate excessively See that the pointer returns to "Zero" when engine is stopped

(m) Vacuum Control Valve: With the engine running, operate the vacuum control handle to "VENTURI" and note the gage reading Turn the handle to the engine pump and note the reading. The gage should read 8.8 to 11.4 cm. Hg. at cruising speed

NOTE: On the ground, the reading for the venturi will be less than stated above.

(n) Propeller Controls: Place safety switches in the "ON" position To check "MANUAL" operations, open throttle to 1000 to 1200 r.p.m. Place selector switch to "MANUAL", and hold down the "DECREASE R.P.M." switch until a reduction in engine r.p.m. is noted . Then hold to "INCREASE R P.M." until original engine r p.m is obtained. (When the engine r p.m ceases to increase, the propeller has reached its minimum pitch angle.)

To check constant speed operation, place selector switch on "AUTOMATIC" and place governor control dial in "TAKE-OFF" position Open throttle until engine turns 1600 to 1800 r.p.m. and turn the governor control dial to low r.p.m

If a reduction in r.p.m. is noted, the control is operating. Return control again to "TAKE-OFF" position.

<u>CAUTION</u>: Before this test, set "MANIFOLD PRESSURE" at 76.2 cm. Hg.

(o) <u>Clock:</u> See that the clock is wound and running and according to the operations office time.

(p) <u>Bomber's Compartment</u>: Make sure the bomber's compartment is fully retracted.

(q) See that the cockpits are free from tools or anything that might shift in flight and interfere with operation of controls.

(r) Make sure that the windshield and enclosures are clean.

(s) Make sure that the fuel and oil tank caps are securely in place.

(t) Make sure that there is ample fuel and oil in tanks for the flight scheduled.

(u) Make sure that engine cowling and all inspection doors and covers are secured.

(v) Check altimeter and set if necessary to the correct altitude.

(w) If the inspection is preparatory for a night flight, check the following:

(1) Cockpit lights and rheostats.

(2) Navigation and formation lights.

(3) Flare holders and release mechanism.

(4) Landing lights.

(5) Signal pistol and cartridges.

D. <u>DAILY</u>

1. <u>Engine Controls</u>

(a) Inspect the operation and general condition of the following assemblies:

(1) Throttle controls

(2) Mixture controls.

(3) Supercharger control.

(4) Propeller Control.

(5) Carburetor air control.

2. Engine Instruments

(a) Inspect as part of the pre-flight inspection.

3. Ignition and Electrical

(a) Check security of spark plug connections.

(b) General conditions and proper functioning to be determined during warm-up See page VIII - 7.

4 Fuel System

(a) Open the fuel valves and operate the wobble pump to bring the fuel pressure up to normal (.840 to .980 Kgs/ cm^2)

(b) Check the primer lines and shut-off cocks for leaks.

(c) Drain all fuel line cocks and strainers and safety the drain cocks.

(d) Drain sump, see page X - 6.

(e) Check the carburetor mounting and air intake duct for security.

5. Oil System

(a) Inspect all accessible lines for evidence of leaks.

(b) Turn oil filter one full turn.

NOTE: Remove and clean oil filter in new or newly overhauled engines, after first five hours of operation. See Page XI - 2.

(c) Inspect all drains and drain plugs for proper safetying.

6 Tanks - Fuel and Oil

(a) Drain fuel tank drains each time fuel is serviced to the airplane.

(b) Inspect all drain plugs for proper safetying.

7. Engine

(a) For detailed inspection and maintenance of valve mechanism and manifolds, see "Instruction Book for Wright Cyclone Engines".

8. Propeller

(a) Check the propeller for looseness on the crank shaft.

(b) Visually inspect the propeller blades and hub, observing the extent to which nicks and dents have occurred on the leading edges. Clean the blades and coat lightly with engine oil.

9. Engine Cowling

(a) Check all cowling for security of attachment.

10. Cockpits and Enclosures

(a) See that the cockpits are kept clean.

(b) Check the adjusting mechanism of both seats.

(c) Inspect the emergency exit operating mechanisms for freedom of operation

(d) Inspect the enclosures for cleanliness and freedom from cracks.

(e) Make sure life preserver cushions are in their proper locations in both cockpits.

11. Navigation Instruments

(a) Inspect navigation instruments for loose mechanical and electrical connections, and pointers.

(b) Inspect airspeed and vacuum lines for tight joints and secure anchorages.

(c) Inspect compass for broken glass, loose cover glass, discoloration of liquid; for evidence of bubbles and defective lamps. Clean cover glasses with a clean cloth.

(d) Check correct functioning and general condition of engine instruments during warm-up.

(e) See Service Manuals issued by manufacturers of instruments supplied, for complete instructions on lubrication, inspection and maintenance.

12. Flight Control Mechanism

(a) Inspect and see that the controls are free from interference and that there is no foreign material which might bind or jam the controls during flight.

(b) Check the rudder and elevator tabs for proper functioning. See that they each have an angular movement of 10° each side of neutral.

13. Flight Control Surfaces

(a) Inspect all control surfaces for holes in the coverings and for general condition of the structure.

(b) Check all control cables for proper security at their junctions and turnbuckles.

(c) Check the landing flap controls and linkage for proper security and see that they are free from dirt. Be sure that the controls and linkage close the flaps properly. See Page XX - 4.

14. Wings

(a) Inspect the general condition of the covering and finish.

(b) Check the operation of ailerons and tabs.

15. Empennage

(a) Inspect the general condition of the covering and finish.

16 Tail Wheel

(a) Inspect the tail wheel unit for the following:

(1) Freedom from mud, grass, etc.

(2) Looseness of the wheel bearings.

(3) Correct inflation of the strut. Consult the plate attached to the strut or to the rudder fairing.

(4) Correct inflation of the tire - 2.5 Kgs/cm^2.

17. Landing Gear

(a) Inspect the landing gear for the following:

(1) Freedom from mud, grass, etc.

(2) Oil leakage at the shock strut.

(3) Correct inflation of the shock strut. See pages XII - 4 and XIII - 6.

(b) Inspect the landing gear operating mechanism for the following:

(1) Freedom from dirt and grit.

(2) Oil leakage at all line fittings and at operating cylinder packing gland.

(3) Full fluid reservoir.

18. Wheels, Brakes and Tires

(a) Inspect wheels for:

(1) Looseness of the wheel bearings.

(2) General condition of wheels and tires.

(3) General operating condition of brakes.

(4) Correct inflation of tires - 2.8 Kgs/cm^2. See page XII - 5.

19. Fuselage

(a) Inspect the general condition of the fuselage covering and finish.

(b) Inspect the flare cases aft of gunner's cockpit for security.

20 Night Flying Equipment

(a) When the airplane is scheduled for a night mission, inspect the installation, condition and operation of:

(1) Cockpit lights and control rheostats.

(2) Navigation, formation and landing lights.

(3) Flare holders and release mechanism.

(4) Signal pistol and cartridges.

21 Fire Extinguisher - Hand

(a) Inspect the hand extinguisher as follows:

(1) That the nozzle hole is not obstructed.

(2) That the bracket is securely attached and in good condition.

(3) That the extinguisher can be removed readily from the bracket.

(4) Replace a leaking extinguisher.

(5) Every 4 months, test extinguisher as directed on plate attached to cylinder.

22. <u>Fixed Gun Sights</u>

(a) Check carefully the following:

(1) Retaining screws and securing nuts for proper security.

(2) That aperture rear sights are clean.

(3) Refer to "Type C-4 Fixed Gun Sights" handbook.

E. <u>WEEKLY</u>

1. <u>Battery</u>

(a) Check the battery with a hydrometer and record the reading of the lowest cell.

(b) Hydrometer readings commonly used for aircraft batteries are:

Low	(discharged)	1.150
Medium	(partly discharged) . .	1.150 to 1.200
High	(fully charged)	1.275 to 1.285

(c) After taking the hydrometer reading, return the electrolyte to the cell from which it was drawn for the reading.

(d) If any cell is either too low or too high, the battery must be removed for inspection and repair.

(e) Add sufficient distilled water to the cells to keep the plates submerged, but do not fill above the splash cover.

<u>CAUTION</u>: <u>Never add any liquid except distilled water.</u>

(f) Inspect terminals for security of connection and cleanliness. If dirty, or if the terminals show signs of corrosion, disconnect and scrape clean. Connect terminals and coat the metal surfaces lightly with petrolatum.

(g) Inspect for leakage of electrolyte. If signs of leakage are found, carefully inspect the surrounding structure for signs of corrosion. Replace a leaking battery at once.

(h) If the airplane is to be idle for seven days or more, the battery should be removed and kept in the battery room.

CAUTION: When using inflammable materials to clean the airplane or engine, the battery switch must be turned off.

F 20 HOUR INSPECTION

1 Starter and Generator

(a) Inspect brushes, brush holders and springs twice each 20 hour period at intervals of 10 hours.

(b) Replace worn brushes.

(c) Inspect the starter pedal and switch for proper operation.

(d) See that generator electrical connections are secure and clean.

2. Engine Controls

(a) Inspect the entire engine control system for:

(1) Free and full movement - controls should operate with uniform tension throughout their full range.

(2) Lost motion or slack.

(3) Bent rods or bell cranks.

(4) Loose or missing bolts, nuts, screws, cotter pins, etc., which are to be tightened or replaced.

(b) See that all adjustments or position locking devices function properly and that all levers are adjusted so as to prevent creeping.

3. Ignition and Electrical

(a) Inspect the ignition system for:

(1) Condition of wiring insulation.

(2) Proper and secure attachment of terminals.

(3) Cleanliness of spark plugs, condition of electrodes, and proper gap settings

(4) Replace damaged spark plug gaskets and when replacing plugs secure tightly to prevent compression leaks.

(b) Inspect all electrical switches and rheostats for condition of contact and correct operation.

(c) Inspect the magnetos for:

(1) Security of hold down bolts.

(2) Looseness, wear or damage in breaker mechanism.

(3) Synchronization of breakers Adjust if necessary.

(4) Proper sealing of joints in the distributor housing. Space between joints will admit dust and moisture.

(d) For detailed inspection, maintenance and lubrication of the magnetos and generator, refer to manufacturers handbooks of instructions

4. Fuel System

(a) Engine cowling should be removed and the wobble pump operated during this inspection.

(b) With fuel on, pressure on, inspect all lines for:

(1) Leaks, particularly at connections.

(2) Cracks, particularly at sharp bends.

(3) Security of the line anchorage.

(4) Wear due to chafing.

(c) Drain the carburetor.

(d) Remove and clean all fuel strainers including carburetor screens.

(e) Clean the strainer bodies and inspect the screens for breaks and tears.

(f) Apply lubricant to aluminum alloy threaded parts before assembling

(g) See Lubrication Chart, page XXIII - 28.

5. Oil System

(a) Remove and clean the oil filter (see page XI - 2), twice during each 20 hour period at intervals of 10 hours.

(b) When oil is drained be sure to drain the sumps.

(c) Inspect the oil lines for:

(1) Leaks, particularly at connections.

(2) Anchorage of lines.

(3) Wear due to chafing.

(4) Dents or cracks.

(d) Inspect the connections for:

(1) Security of the hose clamps. Check for cracks.

(2) Condition of the connecting hose.

(3) Proper location of hose clamps.

(e) Inspect oil cooler for:

(1) Clogged core.

(2) Dents and cracks.

(3) Leaks.

(4) Security of mounting and mounting brackets.

6. Fuel Tanks

(a) Place the airplane in ground position and drain all fuel tanks at the drain cocks. Re-safety the drain cocks.

7. Engine Valve Mechanism and Manifolds

(a) The valve mechanism of the engine on this airplane is pressure lubricated with oil from the engine. See "Instruction Book for Wright Cyclone Engines", for detailed information.

(b) Inspect the intake manifolding for security of mounting and for cracks.

8. Propeller and Accessories

(a) Carefully inspect the blades for scratches, cracks or dents.

(b) See "Installation and Maintenance Instructions", Curtiss Electric Propeller.

9. <u>Cockpits and Enclosures</u>

(a) Inspect the seats for:

(1) Security of attachment, including supports and brackets.

(2) Condition and functioning of adjusting mechanism.

(3) Cracks or breaks in the seat or back, which might foul parachute harnass or clothing.

(4) See Chart, page XXIII - 28 for lubrication.

(b) Replace any safety belt which shows indications of defects or deterioration. Inspect fabric and leather parts for cuts or fraying. See that the latching device is not bent or otherwise damaged.

(c) Inspect the windshield and sliding enclosures for:

(1) Condition of the frame and security of attachment.

(2) See that the material in the windshield joints is intact. If it is cracked or loose, replace with commercial Bostick #292.

(3) Breaks or cracks in the plexiglass.

(4) Condition and operation of the rollers and tracks.

(5) Condition and operation of locks and lock operating mechanism. See Section XV.

10. <u>Gun Tunnel Door</u>

(a) Lubricate the ends of the operating cables and the pedal bearings with machine oil.

11. <u>Bomber's Compartment</u>

(a) Check condition of attaching hinge.

(b) Inspect condition and operation of the retracting mechanism.

(c) Lubricate the operating shaft and hoisting drum bearing with machine oil

12. Flight Control Mechanism

(a) Rudder Pedal Assembly

(1) Inspect the condition and operation of the rudder and brake pedal assembly.

(2) Check the adjustment of the rudder control cables.

(3) Check all turnbuckles and other terminals for proper security.

(4) Check the system for lost motion and insufficient angular travel of rudder.

(5) See page XXIII - 28 for lubrication.

(b) Stick Control

(1) Inspect the condition and operation of the control stick.

(2) Check the adjustment of the control cables. See page XX - 3.

(3) Inspect for lost motion and binding and for the correct angular movement of the elevators and ailerons.

(4) See that the control sticks are secure in their sockets and that the gunner's stick can be readily removed.

(5) Inspect all rods, bearings, pulleys and cables for:

(a) Lost motion; proper safetying of all joints and attachments; frayed cables; misalignment; bent, loose or broken pulleys or brackets.

(b) With the stick in neutral, see that the elevators are in neutral and that the ailerons have a 3/8 inch 9.5 mm droop.

(c) See that the rear stick is either properly secured in its socket or in the stowage strap in the cockpit and that it is in such condition that it can be quickly and easily inserted in, or removed from the socket.

(6) See Section XX for additional information. Page XXIII - 28 for lubrication.

(c) Control Tab Mechanism (Elevators & Rudder)

(1) Inspect condition and operation of the control gears.

(2) Check the control crank and knob for security and unhampered operation.

(3) See page XXIII - 28 for lubrication.

(d) Control Cables & Rods

(1) Inspect all cables and rods constituting the flight control linkage, i.e., the ailerons, elevators, elevator tabs, rudder and rudder tab, and the tail wheel control linkage. Inspection will include cables, rods, pulleys, guides and their connecting linkage and attachment fittings.

(2) Inspect for:

(a) Frayed cables or bent rods.

(b) Loose fittings, turnbuckles, bolts or nuts.

(c) Loose brackets.

(d) Broken or misaligned pulleys.

(e) Proper alignment of all moving parts, particularily noting that cables are not chafing structural parts and are passing freely through holes in the fuselage or wing structure.

(f) Foreign matter near pulley brackets or fairleads that might obstruct the system.

(e) Landing Flap Control System

(1) Check the fluid level in the reservoir. Fill to the top with Lockheed No. 5 Hydraulic Fluid.

(2) Set the selector valve lever in the "DOWN" position and operate the hand pump until the flaps are completely down. Continue to move the hand pump handle while observing the pressure gage. The gage reading will indicate the pressure at which the hand pump relief valve opens. This should occur at 1200^{+50}_{-00} lbs. per. sq. in. ($84^{+3.5}_{-00}$ kgs/cm^2). If adjustment is necessary, refer to page XIII - 5.

(3) Set the selector valve lever in the "UP" position and operate the hand pump until the flaps are completely up. Continue to move the hand pump handle while observing the pressure gage

The gage reading will indicate the pressure at which the flap selector valve relief valve opens. This should occur at 1200 $^{+50}_{-00}$ lbs. per. sq. in. (84 $^{+3.5}_{-00}$ Kgs/cm^2). If adjustment is necessary, refer to page XIII - 5

(4) With the engine pump operating, move the flaps up and down. Observe the pressure gage and note at what pressure the thrust rod knob returns to its aft position. This should occur at 950 $^{+50}_{-00}$ lbs. per. sq. in. (66 $^{+3.5}_{-00}$ Kgs/cm^2). If adjustment is necessary, refer to page XIII - 5

(5) See page XXIII - 28 for lubrication.

(6) Inspect landing flap eye-bolt bushings for wear. These bushings fit snugly when installed, and with proper lubrication should remain satisfactory indefinately They should be replaced however, if wear exceeds 010 inch (.254 mm).

13. Flight Control Surfaces

(a) Rudder, Elevators, Ailerons and Tabs

(1) Check for free full movement

(2) Inspect for warping.

(3) Inspect the covering for tears and looseness.

(4) Inspect the horn and hinge brackets for cracks, corrosion and warping.

(5) Inspect the ball-bearings for loose or missing grease retainers.

(6) Inspect the tabs for loose or worn bearings and for freedom of operation. The bushings should be held to a close fit and should be replaced if wear exceeds .005 inch (.127 mm)

(b) See page XXII - 28 for lubrication of the rudder and elevator tabs, and the landing flaps.

16. Tail Gear

(a) Inspect the entire assembly for the following:

(1) Worn, cut or otherwise injured tire.

(2) Bent or cracked cantilever knuckle.

(3) Bent or broken bearing post.

(4) Binding in the wheel bearings.

(5) Binding in the post bearings.

(6) Cracked or broken pulleys in the steering mechanism and check the steering cables for unhampered operation.

(7) Check the swivel mechanism for proper release and engagement.

(b) Lubricate the assembly as diagrammatically shown on page XXIII - 28.

15. Landing Gear

(a) Inspect the entire assembly for the following:

(1) Check the security of the bolts in the torque tubes and jack shaft bearing retainers at the forward face of web #1.

(2) Check the latch on the retracting link for ease of operation and ample spring torque.

(3) Check the security of all bolts through the torque tube and jack shaft.

(4) Inspect the shock strut torque brace bearings for wear and for ease of operation. They should be replaced if wear exceeds 010 in.(.254 mm).

(5) Check the bolts at the junction of the shock strut and the torque tube, as well as those holding the axle in the shock strut, for security.

(6) Check quantity of fluid in hydraulic fluid reservoir. If not at full level, fill to capacity.

(b) Make a complete and thorough inspection of the retracting and release mechanism. Inspect for fluid leakage, binding and wear.

(c) Check the adjustment of the oleo strut packing.

(d) Check the fluid level in the oleo strut. See page XII - 4 for procedure.

(e) See page XXIII - 29 for landing gear lubrication chart.

16. Wheels and Brakes

(a) Inspect the complete brake operating mechanism as follows:

(1) Check the fluid level in the reservoir, if not at full level, fill to capacity. Reservoir is located on the right forward side of firewall.

(2) Check the operation of the brake pedals and the linkage to the master cylinder.

(3) Inspect all lines for leaks, cracks, kinks, etc.

(b) Adjust brakes according to instructions on page XII - 5.

(c) See page XXIII - 29, landing gear lubrication chart.

G. 40 HOUR INSPECTION

1. Starter and Generator

(a) Inspect the brushes and commutator for roughness. If pitted, smooth with fine sandpaper. Clean all parts thoroughly.

(b) Inspect housings for breaks and cracks, security of mounting and tightness of housing bolts.

2. Ignition and Electrical

(a) Inspect all wiring, both high and low tension, for condition of insulation.

(b) Check all cable for proper anchorage along their full length. No cable should be anchored to fuel or oil lines and no cable should be so loose as to swing freely with the vibration of the engine. If a cable has been loose, check the insulation carefully for wear and for breaks in the wire as the result of fatigue due to vibration.

(c) Check for corrosion or broken strands of wire adjacent to the terminals.

(d) Check the ignition switch at time of engine warm-up.

(e) Inspect all bonding and shielding for looseness and corrosion.

(f) With the generator line switch open, inspect the control box for:

(1) Dirty contacts. Dirt can generally be removed by inserting a clean piece of hard surface paper between the contacts, pressing the contacts together and pulling out the paper. Repeat this procedure several times. Be sure no paper becomes lodged between contact points.

(2) Pitted contacts. Smooth with fine crocus cloth or "tri-mite" paper and then clean with paper.

(g) If the engine has shown indications of roughness, inspect the spark plugs for:

(1) Correct model plugs and gaskets.

(2) Cleanliness and correct setting of the gap.

(3) Tightness of the plugs.

(4) Security of the terminals.

(5) For detailed instructions, see "Instruction Book for Wright Cyclone Engines".

3. <u>Fuel System</u>

(a) Inspect the condition of the bonding lines.

(b) Make sure that the carburetor mounting nuts are tight. See manual for Stromberg carburetor.

4. <u>Oil System</u>

(a) Check all electrical bonding strips to the lines for security.

(b) Remove the oil filter and clean the entire assembly.

(c) Refer to "Inspection Routine", in "Inspection Book for Wright Cyclone Engines".

5. <u>Tanks, Fuel and Oil</u>

(a) Inspect the fuel and oil tanks for:

(1) Security of mounting.

(2) Indications of leakage. If any indication of leakage is evident at the fuel tanks, remove the tank for inspection. See page X - 3.

6 Engine

(a) Clean the exhaust collector ring and check for cracks or burned spots.

(b) Inspect the intake pipes for cracks or dents and for security of attachment.

(c) Oil should be changed after 50 to 60 hours of normal operation.

(d) Thoroughly inspect and adjust the valves.

(e) See "Instruction Book for Wright Cyclone Engines" for complete maintenance instructions.

7. Engine Cowling

(a) Inspect the anti-drag ring and engine accessory cowling thoroughly for:

(1) Worn Dzus fasteners and broken springs.

(2) Worn or cracked cowling, inspect inner and outer surfaces.

(3) Check cowl support pads for wear.

8. Engine Mount

(a) Inspect the engine mount for:

(1) Cracks and abrasions. Clean and cover abrasions with a protective coat of paint. See page XXV - 2.

(2) Loose attaching bolts.

9. Compass

(a) Check the compass for security of mountings, leakage of fluid, defective lighting system, discoloration of liquid, unbalanced correction card. Check for any defect impairing visibility or that might render compass inoperative.

10. Wings

(a) Inspect the wing coverings thoroughly for cracks, dents, loose rivets, etc.

(b) Inspect the covering near the attaching angle, especially on the lower side, for wrinkles. If wrinkles do appear the wing should be removed and the complete structure including the center section inspected and repaired before further flights are made.

(c) Remove the wing attaching angle fairing and inspect the attaching angle for cracks and loose bolts.

11. Landing Flaps

(a) The landing flaps should be carefully inspected for loose or worn hinge pins, worn guide rollers and bushings. Check the entire length of the flaps to make sure they close evenly. If not, adjustment of the actuating links should be made. See page XX - 4.

12. Empennage

(a) Vertical Stabilizer:

(1) Inspect for dents, cracks, or wrinkles in the skin.

(2) Inspect for loose or missing rivets.

(3) Remove the fairing and inspect the attaching bolts for security.

(b) Horizontal Stabilizer:

(1) Inspect for dents, cracks or wrinkles in the skin.

(2) Inspect for loose or missing rivets.

(3) Inspect the attaching angles and the bolts attaching it to the fuselage skin.

(4) Inspect the removable abrasion strip on the leading edge for severe dents and for cracks. Replace if necessary.

13. Tail Gear

(a) Make a complete and minute inspection for wear, cracks, etc., of all fittings, bolts, bearings, etc.

(b) See page XXIII - 28 for lubrication

14. Landing Gear

(a) When practicable and whenever considered necessary, remove the weight from the landing gear and make a complete and minute inspection for wear, cracks, etc., of all fittings, bolts, attaching angles, etc.

(b) Hand Pump Relief Valve. See page XIII - 4 for procedure of checking and adjusting this valve.

(c) <u>Automatic Control Valve Assembly</u>. See page XIII - 5 for procedure of checking and adjusting this assembly

(d) See page XXIII - 29 for lubrication.

15. <u>Bomber's Compartment</u>

(a) Check condition of attaching hinge.

(b) Inspect condition and operation of the retracting mechanism.

(c) Apply soft grease to the worm gear.

16. <u>Wheels and Brakes</u>

(a) Remove the wheels and make a complete and rigid inspection of the entire brake mechanism and control linkage for cracked, broken, worn or loose parts.

(b) See page XII - 5 for detailed procedure of adjustment and service of wheels and brakes.

(c) See Page XXIII - 29 for lubrication of wheel bearings.

17. <u>Night Flying Equipment</u>

(a) Inspect the flares and flare cases for:

(1) Dents or corrosion

(2) Wear of carrying hook.

(3) Damage to or deterioration of cardboard body covering the illuminant.

(4) Damaged hangwire.

(5) Corrosion of the container or other visible defects.

(b) Check flare carrying and release mechanisms for proper operation.

18. <u>Battery Box</u>

(a) Carefully inspect the battery box and the surrounding structure for corrosion.

(b) Clean any corroded spots and re-coat with acid resisting paint.

19. Engine Change

(a) A complete 40 - hour inspection should be accomplished each time an engine is changed.

20. Fixed Gun Sights

(a) Check carefully the following:

(1) Security of attached mounting posts.

(2) No shake in any part of vertical and lateral adjustments.

(3) Defective joints at the posts, damaged rings, corrosion.

(4) Lubricate all working parts except slides, with light engine oil. External surfaces to have all excess oil removed.

(b) For complete maintenance and lubrication, refer to the "Type C-4 Fixed Gun Sights" handbook.

21. Aero Mixture Indicator

(a) If for any reason (engine change, cleaning, repair, etc.), the sampling nipples or tubing of the Aero Mixture Indicator are removed, a flow test of the subsequent installation should be made in accordance with instructions found on page XXII - 3.

H. 100 HOUR INSPECTION

1. Starter

(a) For service maintenance and inspection, refer to the "Eclipse Service Instructions".

2. Generator & Control Box

(a) For service maintenance and inspection refer to the "Eclipse Service Instructions".

3. Fuel System

(a) Drain the fuel system by opening all valves and drain plugs and blow out the entire system with compressed air. Clean strainers. Be sure to remove filler caps before applying compressed air.

(b) Remove and drain the carburetor.

4. Engine and Propeller

(a) For complete maintenance, refer to the "Instruction Book for Wright Cyclone Engines", and "Installation and Maintenance Instructions, Curtiss Electric Propeller".

(b) Oil carburetor after draining.

(c) Check the breather screen for cleanliness.

NOTE: When having an engine overhauled, it is essential to have the magnetos, carburetor and fuel pump overhauled at the same time.

5. Wings

(a) Remove the attaching angle fairing and inspect the attaching angles for cracks, loose bolts and rivets.

6. Compass

(a) Compass should be compensated and reading recorded at the end of 100 hours of flying and at the time of an engine change, a change of guns or electrical equipment which is likely to affect the compass, or at least once during each three months period.

7 General

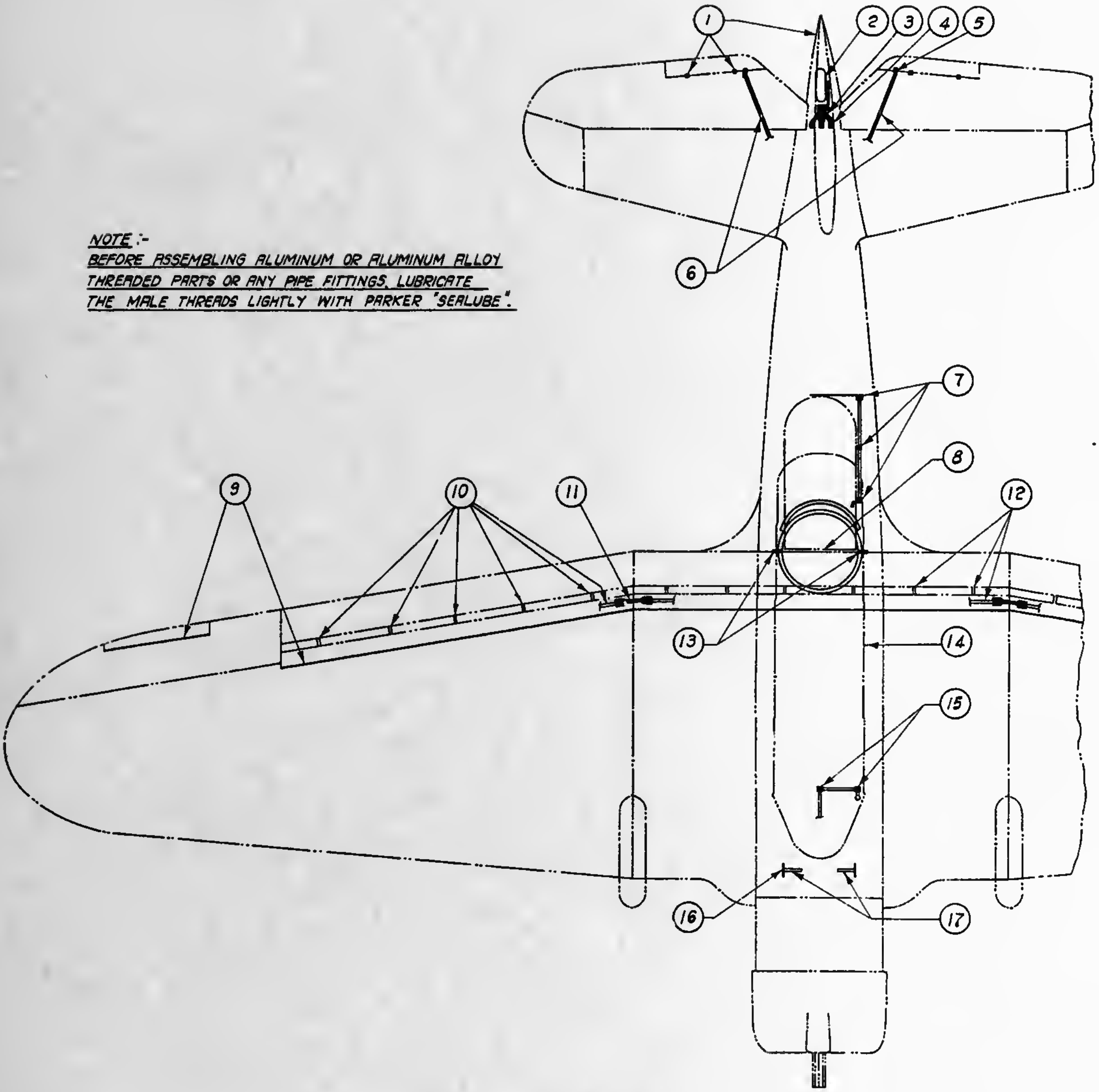
In addition to the foregoing, complete pre-flight, daily, weekly, 20 and 40 hour service routines should be carried out at each 100 hour period of the airplane's flying time.

I. FOUR MONTHS INSPECTION

1. Fire Extinguisher - Engine

(a) It is recommended that the system be tested once every four months. If the system is not discharged, as required in testing, the cylinder should be removed and weighed. If, when weighing the cylinder, it is found that the gas charge is less than the amount specified by 4 ounces (113 grams) or more, the cylinder should be recharged.

(b) See Instruction Book for Lux Fire Extinguishers, Walter Kidde & Co., Inc. for complete instructions of description, operation, installation and maintenance for the fire extinguisher system.



NOTE :-
BEFORE ASSEMBLING ALUMINUM OR ALUMINUM ALLOY THREADED PARTS OR ANY PIPE FITTINGS, LUBRICATE THE MALE THREADS LIGHTLY WITH PARKER "SEALUBE".

		EACH 20 HOURS	EACH 40 HOURS	EACH 80 HOURS
1	TAB HINGES (2 EACH TAB)	P.O.		
2	TAIL WHEEL (PACK BEARINGS)			G
3	TAIL WHEEL STEERING ARM & PULLEY SWIVEL BOLTS (ALL CABLE CONTROL CLEVISES)	E.O.		
4	TAIL GEAR (5 PLACES)	G		
5	TAB OPERATING TUBE ENDS * (RUDDER TUBE NOT SHOWN)			G
6	TAB OPERATING TUBE UNIVERSAL JOINTS (RUDDER TUBE NOT SHOWN)	P.O.		
7	BOMBER'S COMPARTMENT GEAR CONTROL	P.O.		
8	BOMBER'S COMPARTMENT HINGE	P.O.		
9	FLAP & TAP HINGES	P.O.		
10	WING FLAP EYE BOLTS, BEARINGS, LINKS & ROD ROLLERS * *	P.O.		
11	FLAP ROD UNIVERSAL JOINTS	E.O.		
12	CENTER SECTION FLAP EYE BOLTS, BEARINGS, LINKS & ROD ROLLERS * *	P.O.		
13	GUNNER'S SEAT RING (2 PLACES) * * *		G	
14	COCKPIT ENCLOSURE ROLLERS	E.O.		
16	WOBBLE PUMP CONTROL (2 PLACES)	G		
	WOBBLE PUMP LINKS	E.O.		
16	PARKING BRAKE RATCHET SHAFT	G		
17	BRAKE & RUDDER PEDAL LINKAGES	P.O.		

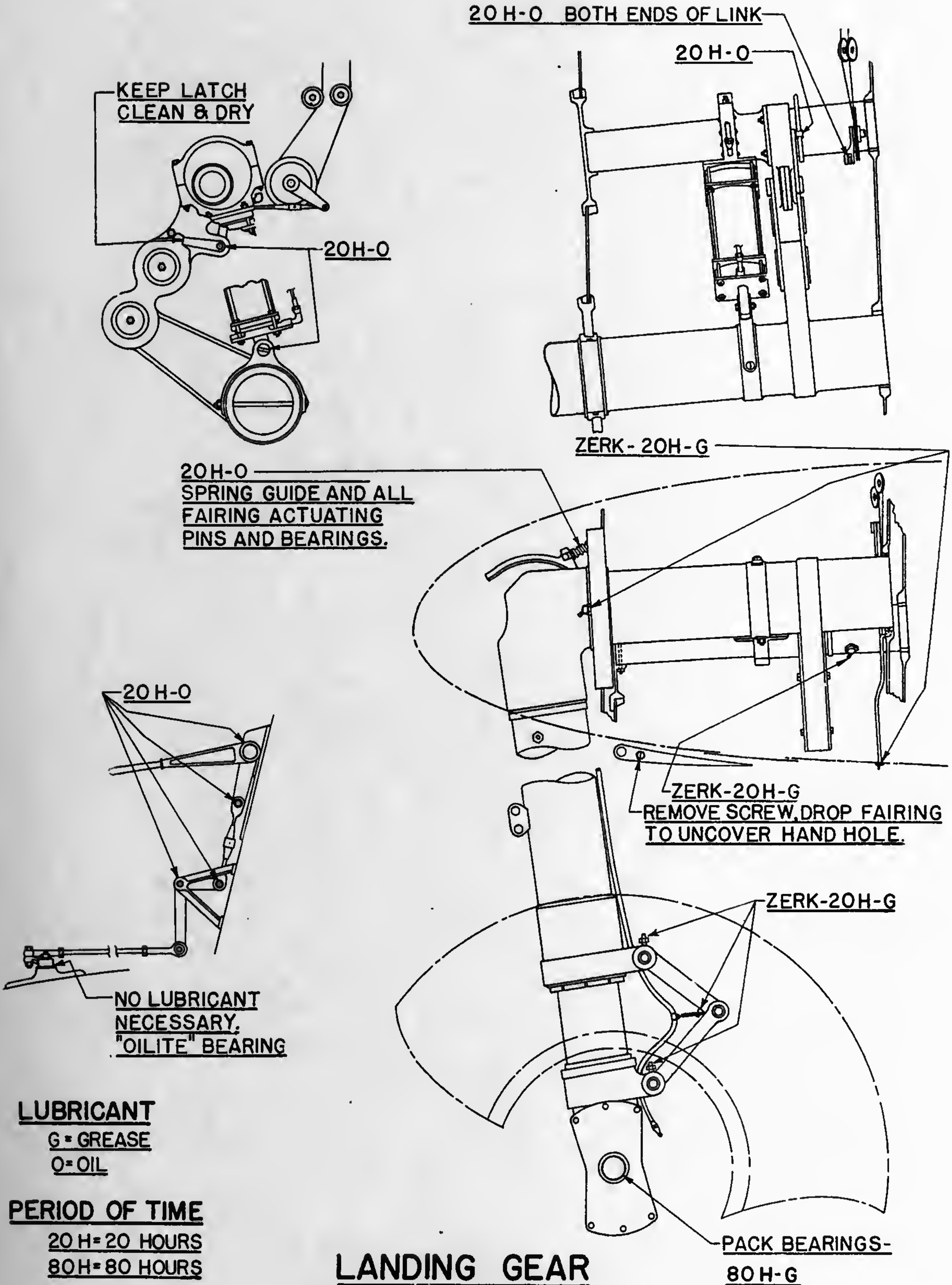
* REMOVE TABS TO LUBRICATE

* * SPRAY WITH SOLVENT TO REMOVE ALL DIRT, GRIT, AND EXCESS OIL AND GREASE

* * * REMOVE PINS BEFORE LUBRICATING.

G - GREASE
P. O. - PENETRATING OIL
E. O. - ENGINE OIL

LUBRICATION CHART



LANDING GEAR LUBRICATION CHART

J. INSPECTION LISTS

In order that every specific system or unit on the airplane may be completely prepared for flight, the manufacturer has provided the following lists as a guide for the Inspection Department. In the interest of safety, it is suggested that operators' inspectors use these lists as a guide after major overhauls and as preflight inspections when applicable.

1. FUSELAGE & EQUIPMENT

ITEM	CHECK FOLLOWING	DESIRED RESULTS
a. (1)	Enclosure Latches (forward & rear)	Operate satisfactorily in all locking positions.
(2)	Enclosure Tracks	Free of any loose or abrasive material.
(3)	Enclosure Rollers	Screws tight and cottered. Rollers do not bind in track.
b. (1)	Pilot's Seat Locking Pins	Engage properly and positively.
(2)	Pilot's Seat and Slide Tube Supports	All attaching bolts tight.
(3)	Safety Belt Attachments	Properly secured.
c. (1)	Gunner's Seat	Hinge pins properly secured.
(2)	Gunner's Safety Belt	Properly secured.
(3)	Gunner's Seat Tilt Structure	Latches secure.
d. (1)	Bomber's Compartment and Mechanism	Operate positively and freely. Important that latch operates securely.
e. (1)	Aft Gun Tunnel Doors and Mechanism	Operate properly and freely. Hinge pins and latches secure.
f. (1)	Oxygen and CO_2 Containers NOTE: Oxygen lines and equipment to be free of oil and grease at all times.	Containers secure and all lines tight.

ITEM	CHECK FOLLOWING	DESIRED RESULTS
(2)	Oxygen Masks and Hoses	All are in place, clean and properly attached.
(3)	Hand Fire Extinguisher	Properly secured and filled. Weigh every 4 months.
g. (1)	Engine Crank	Properly stowed and fastened securely.
h. (1)	First Aid Kit	Properly filled and stowed. Fasten securely.

2. WINGS AND EMPENNAGE

a. Center Section:

(1)	Main Fittings to Fuselage	Bolts tight and safetied.
(2)	Vent Line to Fuselage	Open - no leaks.
(3)	Landing Flaps	Free movement, hinge pins safetied, operating bearing support bolts tight and safetied Operating rod to flap linkage attachment tight and safetied
(4)	Landing Gear Strut Closing Door	Attaching bolts tight and safetied.

b. Wing:

(1)	Main Attachment to Center Section	Bolts tight (2 bolts to web #2).
(2)	Vent Line to Center Section	Couplings and clamps tight. No leaks.
(3)	Ailerons	Free movement, full throw.
(4)	Hinge Bearing Supports	Bolts tight and safetied.
(5)	Landing Flaps	Free movement - hinge pins safetied, operating rod bearing support bolts tight and safetied. Operating rod to flap linkage attachment tight and safetied.

ITEM	CHECK FOLLOWING	DESIRED RESULTS
c. Empennage:		
(1)	Horizontal Stabilizer	Anchorage bolts tight and safetied.
(2)	Elevator	All bolts tight and safetied.
(3)	Rudder	All bolts tight and safetied.
(4)	Fairing	Attaching bolts tight and safetied.

3. POWER PLANT

ITEM	CHECK FOLLOWING	DESIRED RESULTS
a.	Engine Mount	
b.	Engine Mount Attaching Bolts at Firewall	Tight and safetied.
c.	Engine to Mount Attaching Bolts	Tight and cottered.
d.	Hand Fuel Pump and Lines to Engine	No leaks at starting pressure.
e.	Fuel Shut-off Controls	Check positions.
f. (1)	Direction of Travel of Engine Controls at Engine per Position of Levers in Cockpit	Cables, rods and turnbuckles rigged and safetied.
(2)	Throttle	Lever forward - throttle open.
(3)	Mixture	Lever forward - mixture rich.
(4)	Carburetor Air Intake Control	
(5)	Propeller Governor Control	
(6)	Supercharger Controls	Lever forward - blower high. Lever back - blower low.
g.	Engine Control Jack Shaft	Bolts and nuts tight and safetied.
h.	Anti-drag Cowling	Dzus fasteners fast, trunnions tight and safetied.

ITEM	CHECK FOLLOWING	DESIRED RESULTS
i.	Diaphragm	All bolts tight.
j.	Accessory Cowling	Dzus fasteners tight.
k.	Oil Lines	No leaks - hose clamps tight.
l.	Instrument Lines	No leaks - hose clamps tight.
m.	Propeller Installation	Satisfactory installation.
n.	Oil Cooler Mounting	Clamps tight - nuts cottered.
o.(1)	Fire Extinguisher - CO_2 Bottle	Secure and full.
(2)	CO_2 Lines	Connections tight.

4. ARMAMENT

ITEM	CHECK FOLLOWING	DESIRED RESULTS
a.(1)	Gun Trunnion and Rear Post Bracket Ball Retainers	Secured properly to posts.
(2)	Rear Post Lock Nuts	Secured tightly against bracket.
(3)	Flexible Gun Yoke and Post	Properly secured to gun truck.
(4)	Gun Covers and Fairing, Ammunition Access Doors, Bomb Fairing Access Doors	Properly secured.

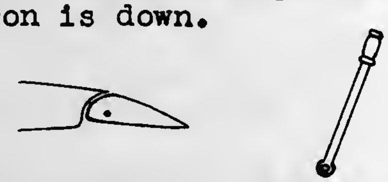
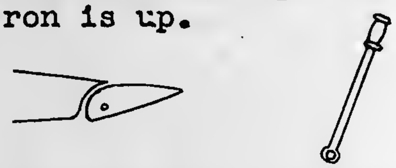
5. FLIGHT CONTROLS DIRECTIONAL CHECK LIST

Model 8A-5 Shop Order 300 Ship No.____

Inspector's stamp in block indicates that item inspected is found to be correct.

	All instructions are for inspection facing forward except as noted.	INSPECTOR'S STAMP L.H.	INSPECTOR'S STAMP R.H.	REMARKS
Elevator Motion	1. With pilot's stick aft the rear cockpit stick is aft.			
	2. With pilot's stick aft the elevators are up.			
	3. Elevator motion up is 30° or 11 3/8" measured at maximum chord.			
	4. Elevator motion down is 20° or 7 5/8" measured at maximum chord.			
Rudder Motion	5. With pilot's left rudder pedal depressed to limit, rear cockpit left rudder pedal is forward when engaged.			
	6. With pilot's left rudder pedal depressed to limit, rudder has moved to left.			
	7. Rudder motion to left is 30° or 15 1/16" measured at maximum chord.			
	8. Rudder motion to right is 30° or 15 1/16" measured at maximum chord.			
Elev. Tab Motion	9. When elevator tab indicator reads "HALE NED", elevator tabs are up.			
	10. Elevator tab motion up is 10° or 7/8" measured at the root.			
	11. Elevator tab motion down is 10° or 7/8" measured at the root.			

Inspector's stamp in block indicates that item inspected is found to be correct.

	All instructions are for inspection facing forward except as noted.	INSPECTOR'S STAMP L.H.	INSPECTOR'S STAMP R.H.	REMARKS
Rudder Tab Motion	12. When rudder tab indicator reads "H", rudder tab has moved to left.			
	13. Rudder tab motion to left is 10° or 7/8" measured at the root.			
	14. Rudder tab motion to right is 10° or 7/8" measured at the root.			
Aileron Motion	15. With pilot's stick to right the rear cockpit stick is right.			
	16. With pilot's stick to right the left aileron is down. 			
	17. With pilot's stick to right the right aileron is up. 			
	18. With pilot's stick vertical both ailerons droop 3/8" below the trailing edge of wing. 			
	19. Aileron motion up is 21° or 6 1/4" measured at the root.			
	20. Aileron motion down is 14° or 4 1/4" measured at the root.			

6. LANDING GEAR AND HYDRAULIC FINAL INSPECTION CHECK LIST.

MODEL. 8A-5 AIRPLANE No. ___________

ITEM.	No	PROCEDURE.	DESIRED RESULTS.	FINAL RESULT.	INSPECTOR	DATE.
MAIN LANDING GEAR.	1	SUPPORT AIRPLANE ON STANDS IN FLYING POSITION.-CONNECT UP HYD. TEST STAND. USE A PESCO 203AD (OR EQUIV.) HYDRAULIC ENGINE PUMP ON STAND.	HYDRAULIC SYSTEM RESERVOIR SHOULD BE FULL AS PER INSTRUCTIONS ON RESERVOIR.			
		FILL HYD. RESERVOIR AND THE SYSTEM, AND THE HYD. BRAKE RESERVOIR WITH LOCKHEED HYD. FLUID #5 OR EQUIV.	HYDRAULIC BRAKE RESERVOIR SHOULD BE FULL AS PER INSTRUCTIONS ON RESERVOIR.			
	2	WITH TEST STAND PUMP OPERATING 3300 R.P.M., PLACE LANDING GEAR OPERATING LEVER IN "UP" POSITION TO RETRACT THE LANDING GEAR. SEE IMPORTANT NOTES. MARKED ⊛ *	WITH LEVER IN "UP" POSITION, GEAR SHOULD RETRACT & LOCK IN "UP" POSITION IN APPROX. 10 SECONDS.			
			INDICATORS ON TOP OF WINGS SHOULD INDICATE "GEAR UP"			
			THERE SHOULD BE NO INTERFERENCE OR LEAKAGE OF ANY KIND.			
	3	PLACE LANDING GEAR OPERATING LEVER IN "DOWN" POSITION TO EXTEND THE GEAR. SEE NOTE MARKED *	WITH LEVER IN "DOWN" POSITION, GEAR SHOULD EXTEND AND LOCK "DOWN" IN APPROX. 10 SECONDS.			
			INDICATORS ON TOP OF WINGS SHOULD INDICATE "GEAR DOWN"			
			THERE SHOULD BE NO INTERFERENCE OR LEAKAGE OF ANY KIND.			
WING F	1	PLACE FLAP OPERATING LEVER IN "DOWN" POSITION TO OPEN WING FLAPS. SEE NOTE MARKED ⊛	WITH LEVER IN "DOWN" POSITION, FLAPS SHOULD OPEN TO 45° IN APPROX. 3 SECONDS.			
			POSITION INDICATOR, IN FORW'D. COCKPIT, ON LEFT HAND SIDE & AHEAD OF FLAP OPERATING LEVER, SHOULD INDICATE "FLAPS" OPEN"			
			THERE SHOULD BE NO INTERFERENCE OR LEAKAGE OF ANY KIND.			
	2	PLACE FLAP OPERATING LEVER IN "UP" POSITION TO CLOSE WING FLAPS.	WITH LEVER IN "UP" POSITION, FLAPS SHOULD CLOSE IN APPROX. 3 SECONDS.			
			POSITION INDICATOR IN FORWD			

FLAPS.			AHEAD OF FLAP OPERATING LEVER SHOULD INDICATE "FLAPS CLOSED."			
			THERE SHOULD BE NO INTERFERENCE OR LEAKAGE OF ANY KIND.			
	3	PLACE FLAP OPERATING LEVER IN "DOWN" POSITION TO OPEN FLAPS HALF-OPEN. THEN PLACE LEVER IN THE "NEUTRAL" POSITION.	FLAPS SHOULD REMAIN IN POSITION (ONE-HALF OPENED) AND RESIST ANY FORCE WHICH MAY HAVE A TENDENCY TO FURTHER OPEN OR CLOSE THEM.			
			THERE SHOULD BE NO INTERFERENCE OR LEAKAGE OF ANY KIND.			
BRAKES	1	BLEED BOTH BRAKES OF AIR. CHECK FLUID LEVEL IN HYDRAULIC BRAKE RESERVOIR AND FILL IF NECESSARY. BRAKE LINE BLEEDER CONNECTIONS ARE LOCATED ON INBOARD SIDE OF BRAKE DRUMS, DIRECTLY ABOVE THE HOSE CONNECTIONS.	PEDAL ACTION SHOULD BE SOLID. SPONGY ACTION INDICATES "AIR IN SYSTEM."			
	2	APPLY AND RELEASE BRAKES APPROX. 8 OR 10 TIMES.	WHEELS SHOULD LOCK.			
			WHEELS SHOULD TURN FREELY. 2 SECONDS MAX. LAG.			
			PEDAL ACTION SHOULD NOT BE SPONGY.			
	3	APPLY AND RELEASE PARKING BRAKES.	WHEELS SHOULD TURN FREELY. 2 SECONDS MAX. LAG.			
			THERE SHOULD BE NO LEAKS OF ANY KIND.			
TAIL WHEEL	1	OPERATE RUDDER PEDALS TO GIVE RIGHT RUDDER.	TAIL WHEEL SHOULD LEAD TO RIGHT WITH RUDDER.			
	2	OPERATE RUDDER PEDALS TO GIVE LEFT RUDDER.	TAIL WHEEL SHOULD LEAD TO LEFT WITH RUDDER.			
	3	PIVOT TAIL WHEEL LATERALLY BY HAND WITH A FIRM, QUICK, JERK TO RELEASE CENTERING CAM.	TAIL WHEEL SHOULD RELEASE AND SWIVEL 360° IN DIRECTION OF JERK, EITHER RIGHT OR LEFT, UNTIL THE ORIGINAL POSITION IS AGAIN REACHED WHERE IT WILL AGAIN CENTER AND CATCH.			
HYDRAULIC HAND	1.	STOP ENGINE PUMP ON TEST STAND. OPERATE WING FLAPS OPENING AND	WING FLAPS SHOULD OPEN AND CLOSE. THERE SHOULD BE NO LEAKAGE			

HAND PUMP		OPERATE WING FLAPS, OPENING AND CLOSING THEM USING HAND PUMP PRESSURE.	THERE SHOULD BE NO [illegible] OF ANY KIND.		
LANDING GEAR.	1.	REMOVE AIRPLANE FROM STANDS. CHECK ALL TIRES FOR INFLATION.	TIRES SHOULD BE INFLATED AS PER INFLATION LINE ON TIRE.		
ENGINE DRIVEN PUMP	1.	DISCONNECT TEST STAND HYD. PUMP AND CONNECT HYD. SYSTEM TO THE ENGINE-DRIVEN PUMP, ON ENGINE. RUN ENGINE 900 TO 1000 R.P.M.			
	2.	OPERATE WING FLAPS, COMPLETING OPENING OPERATION AND THEN CLOSING FLAPS.	WING FLAPS SHOULD OPEN AND CLOSE.		
FLUID. SUPPLY	1.	CHECK FOR PROPER OIL LEVEL IN BOTH HYDRAULIC SYSTEM AND BRAKE SYSTEM RESERVOIRS. FILL IF NECESSARY.	RESERVOIRS SHOULD BE FULL AS PER INSTRUCTIONS ON EACH RESERVOIR.		

⊛ BEFORE PROCEDING WITH TESTS, OPERATE WING FLAPS AND LANDING GEAR REPEATEDLY BY OPERATING LEVERS, UNTIL ALL AIR IN THE SYSTEM IS EXPELLED AND ANY JERKY OR UNEVEN ACTION IN THEIR OPERATION IS ELIMINATED; ALL ACTION SHOULD BE SMOOTH & EVEN.

* WARNING HORN, INOPERATIVE DURING GROUND TESTS, SOUNDS WHEN THE LANDING GEAR IS IN ANY OTHER THAN "LOCKED DOWN POSITION & IF ENGINE IS TURNING LESS THAN 1500 R.P.M. HORN STOPS SOUNDING WHEN GEAR LOCKS DOWN, OR WHEN ENGINE TURNS FASTER THAN 1500 RPM. (APPROX)

R.H. FRANKLIN. SEPT. 19. 1940.

7. INSTRUMENTS

(All Instruments in Front Cockpit Except as Noted)

ITEM	CHECK FOLLOWING	DESIRED RESULTS
a. (1)	Airspeed Indicator Pioneer	Pressure and static lines tight. No air leaks. No obstruction in lines.
(2)	Pitot Static Head (24 V.) Kollsman	No obstructions in intake port and drain hole. Lines tight. Heater element functions.
b.	Altimeter-Sensitive Pioneer	Static line tight. No air leaks. No obstructions.
c.	Turn and Bank Indicator Pioneer	Vacuum line tight. No air leaks. Turn indicator free. No obstructions in lines, set vacuum 2 inches Hg. = (5.08 cm.)
d.	Compass-Magnetic Pioneer	Compass card riding free. Support not restricted on shock mounts. Magnetic material causing deviation held to minimum.
e.	Rate of Climb Indicator Pioneer	No leaks in static line. No obstructions in lines.
f.	Artificial Horizon Sperry	Line tight. No air leaks. Instrument operates at 3.5 to 4 inches Hg. = (9 to 10 cm.).
g.	Suction Gage Pioneer	3-1/2 to 4 inches Hg. = (9 to 10 cm.). Correct vacuum for instrument at cruising speed (1900 r.p.m.).
h.	Clock (Sweep second hand) Pioneer	Hands move freely. No obstructions or dirt in case.
i.	Outside Air Temperature M.M.M.	Capillary tube not crushed. Connections tight.
j.	Engine Gage Unit Oil Pressure Fuel Pressure Oil Temperature M.M.M.	No leaks in oil or fuel pressure lines. Capillary tube not crushed.

ITEM	CHECK FOLLOWING	DESIRED RESULTS
k.	Engine Temperature Thermocouple Lewis	All thermocouple leaks secure at engine and instrument. Firewall disconnect plug secure. Contacts clean.
l.	Manifold Pressure Gage Pioneer	Lines tight. No leaks.
m.	Carburetor Air Thermometer M.M.M.	Capillary tube not crushed. Connections tight.
n.	Tachometer-Centrifugal Pioneer	Tachometer shaft connections tight. Bend radii not too sharp.
o.	Fuel Level Gage Motometer	No air leaks. Lines free from dirt and moisture.
p.	Fuel Gage Selector Switch Yaxley	Switch operating properly to select desired tank.
q.	Vacuum Relief Valve (In Engine Section at Vacuum Pump)	Set at 3.5 to 4 inches Hg. = (9 to 10 cm.)
	(Instruments in Rear Cockpit)	
r.	Compass-Magnetic Pioneer	Compass card riding free.
s.	Altimeter-Sensitive Pioneer	Static line tight. No air leaks.
t.	Airspeed Indicator Pioneer	Pressure and static line tight. No air leaks.

CHECK FOLLOWING	DESIRED RESULTS
Propeller Control Relay Box Curtiss	Free on shock mounts. Contact points not pitted. Conduit fittings and plugs tight.
Propeller Unit Curtiss	Plugs tight. Contacts clean.
Proportional Governor Curtiss	Plugs tight. Contacts clean.
Propeller Feathering Control Box Curtiss	Switches operating properly. Plug at firewall tight and safetied.
Fuses	Fuses not discolored including all spares Red side not visible on fuse holder.
Fuel Pressure Warning Switch Pioneer	10-1/2 to 11 lbs/sq.in.=.738 to .7734 kgs/cm^2.
Bomb Switches Cutler-Hammer	Adjusted to firing order noted on drawing.
Throttle Warning Switch Cutler-Hammer	To turn on at point slightly less than cruising speed.
Landing Gear Warning Switches Micro.	Adjusted to make contact at proper time.
Landing Gear Warning Horn	Check horn circuit with wheels retracted and throttle closed.
Gun Solenoids 30 Cal. Left and Right	Plugs tight Circuit complete through solenoid. Contacts clean.
Gun Solenoids .50 Cal. Left and Right	Contacts clean. Plug tight. Circuit complete through solenoid.
Landing Lights-Left and Right Adams & Westlake	See paragraph "c".
Cockpit Lights-Left and Right (Front Cockpit)	See paragraph "c".

CHECK FOLLOWING	DESIRED RESULTS
Gun Switch Box Light and Bomb Indicating Lights (8) (Front Cockpit)	See paragraph "c"
Flight Instrument Panel Lights: (Front Cockpit) Gunner's Signal Fuel Pressure Warning Intervalometer Artificial Horizon Instrument Panel Lights - (3)	See paragraph "c".
Right Hand Instrument Panel Lights (2) (Front Cockpit)	See paragraph "c"
Intervalometer Light and Extension Light (Rear Cockpit)	See paragraph "c"
Gunner's Signal Light (Rear Cockpit)	See paragraph "c".
Cockpit Lights (2) (Rear Cockpit)	See paragraph "c".
Horizontal Stabilizer Lights (Left and Right)-(2 each)	See paragraph "c"
Wing Tip Lights (Left and Right)-(3 each)	See paragraph "c".
Tail Lights (2)	See paragraph "c"

SECTION XXIV

HEAT TREATMENT AND FIELD REPAIRS

A. HEAT TREATMENT OF METALS

1. All non-ferrous metals are heat treated according to specification A.C. 98-10026A, and all types of steel to specification A.C. 98-10025A. Spring steel is further heat treated according to specification N.A.F. PH-4.

2. The heat treatment of all nickel steel includes a minimum untimate tensile strength of 8800 kgs./cm^2.

3. There are a few special cases involving the use of C.M. Steel where heat treatment of more than the normal 6300 kgs./cm^2 is required. These include the landing gear oleo piston and cylinder which are heat treated to 10,500 to 12,000 kgs./cm^2, and bomb rack parts which are heat treated to between 11,000 and 12,500 kgs./cm^2.

4. Tensile strength requirements of the metal installed in the airplane may be obtained from the heat treatment information as given in title block of blueprint copies of drawings.

5. The Field Repairing paragraphs of this section cover the suggested emergency repairs of typical parts of the airplane. Circumstances and local conditions will determine the extent to which field repairing can be accomplished and this section is written with that in mind.

6. Aluminum and aluminum alloy should be heat treated or annealed according to the following charts:

	MATERIAL	TEMPERATURE °C	TIME AT HEAT (Electric Furnace)		QUENCH
HEAT TREATMENT			Thickness (m m.)	Minutes	
	* 24 S	$495^\circ \pm 5^\circ$	.25 to .812	30	In water under 30°C as quickly as possible. 5 secs. is recommended max. time before quench
			to - 1.01	30	
			to - 1.62	30	
			to - 2.31	35	
	AL 24 S	$495^\circ \pm 5^\circ$	to - 3.25	45	
			to - 4.76	50	
			to - 6.35	60	
			to -12.70	90	

* This material must always be quenched in water.

	MATERIAL	TEMPERATURE °C	TIME AT HEAT (Electric Furnace)	QUENCH
ANNEALING	17 S 24 S	Heat treated material 425° ±5°	Two Hours	Cool in furnace to not more than 25°C per hour down to 230°C
	*See Note: - below	Strain hardened, un-heat treated matl. 345° ±5°	To Heat	
	2 S	425° ±5°	All gages 30 mins.	Air
	3 S	425° ±5°	All gages 30 mins.	Air
	4 S	425° ±5°	All gages 30 mins.	Air

* NOTE: Alclad material is not be be annealed.

7. Unless heat treatment of aluminum and aluminum alloy is thoroughly understood, it is advisable to consult a metallurgist for the following:

   (a) Heat treating time for all pieces where any point is more than 6.35 mm. from the nearest surface.

   (b) Heat treating or annealing any other alloys.

   (c) Disposition of any material not prescribed for herein.

8. Quenching Procedure

   (a) Air Quenching

   (1) Air quenching should be used only when it is known that distortion will result from water quenching. This applies to Alclad materials only. 24ST should never be air quenched.

   (2) Move the material rack carriage to position in front of furnace door.

   (3) Open furnace door and draw the material rack out onto the rack carriage. Close furnace door.

   (4) Move carriage, rack and material into position in front of fan, start fan to quench. Use fan that is sufficiently large for material to be quenched. The velocity of the air current should be as high as possible.

   (b) Water Quenching

   (1) Water quenching should be used whenever possible.

   (2) Have water quench frame in the up position above the tank, ready to snap into place, raise the furnace door and as it is rising connect drag rod to rack. When door is completely up, lock frame to furnace rails.

(3) Pull material rack out of furnace, in and onto quenching frame, and on, - thus plunging the load suddenly down into water to quench.

(4) Close furnace door. Approximate maximum time for complete operation - 5 seconds.

(c) Soaking periods in air furnaces provided with air circulation:

(1) In general the optimum soaking period for any alloy will depend on the type of heating medium, the type of alloy, the prior heat treatment or mechanical treatment to which the alloy has been subjected. Also the size and shape of the part or parts being treated. The suggested periods for soaking material in the heat treated temper (re-heat treatment of material in condition "T") and for soaking material in the soft (heat) temper (heat treatment of material in condition "A") are shown in the following table:

NOMINAL THICKNESS MM.	ALLOY 17 CONDITION "A" TIME AT HEAT	ALLOY 17 CONDITION "T" TIME AT HEAT	ALLOY 24 CONDITION "A" TIME AT HEAT	ALLOY 24 CONDITION "T" TIME AT HEAT
Up to .793	20 min.	10 min.	30 min.	15 min.
over .793 to 1.587	25 min.	10 min.	40 min.	15 min.
over 1.587 to 3.175	30 min.	15 min.	45 min.	20 min.
over 3.175 to 6.350	45 min.	20 min.	60 min.	30 min.
over 6.350 to 12.70	60 min.	30 min.	90 min.	45 min.
over 12.70	90 min.	45 min.	120 min.	45 min.

NOTE: When a charge includes parts of various thicknesses or as overlapping members the entire charge should be soaked continuously for the period required for the greatest thickness. In the case of alloy, Alclad A17 and A24, the soaking periods should be restricted to the minimum necessary to produce the required properties

(2) Size of charge should be regulated to avoid undue cooling of the furnace when charge is introduced.

(3) Quenching in water at below 30°C, as quickly as possible (5 seconds is recommended maximum time after leaving the furnace.)

9. Annealing

(a) Alloys Alclad 17 and 24 should not be fully annealed for relief of hardness by previous heat treatment. If this material is required in the annealed condition, it should be purchased annealed.

(b) The annealing procedure to be followed in any case will depend upon the prior treatment of the material and the degree of softness desired. Annealing may be used for relief of hardness caused by cold working of the material not previously heat treated, or for relief of hardness caused by prior heat treatment. The degree of anneal desired may be either a partial anneal or a full anneal.

(c) Full anneal, for relief of hardness, materials not previously heat treated:

MATERIAL	TREATMENT	TIME
17 S & 24 S	Heat to a uniform temperature within the range of 340°C to 355°C. Cool slowly in air.	To heat

(d) Partial anneal for relief of hardness caused by previous heat treatment:

MATERIAL	TREATMENT	TIME
17 S & 24 S	Repeat as above or heat to a uniform temperature within the range of 400°C to 425°C Quench in air or water	To heat

(e) Full anneal for relief of hardness caused by previous treatment

MATERIAL	TREATMENT	TIME
17 S & 24 S	Heat to a uniform temperature within the range of 420°C to 430°C. Soak for 2 hrs. cool slowly approximately 30°C decrease per hour to 235°C after which more rapid cooling is permissible.	To heat

(f) Aluminum and aluminum alloys:

MATERIAL	TEMPERATURE	TIME	QUENCH
2 S	340°C ± 8°	To heat	Air
3 S	400°C ± 8°	To heat	Air
4 S	400°C ± 8°	To heat	Air

10. Chrome Molybdenum Steel

(a) The following information describes the heat treating of Chrome molybdenum steel to obtain the physical qualities indicated in the table below:

Normalized	6,300 - 8,100 kgs/cm^2
Heat Treated	8,800 - 9,800 kgs/cm^2 permissible for all sizes.
Heat Treated	10,500 - 11,600 kgs/cm^2 maximum allowable for material under 1.65 mm. thick.
Heat Treated	12,500 - 13,500 kgs/cm^2 maximum allowable for material 1.65 mm. to 3.04 mm. thick.
Heat Treated	14,000 - 15,500 kgs/cm^2 maximum allowable for material more than 3.04 mm. thick.

The blueprint of the drawing concerned specifies the heat treated condition of the metal as it is installed in the airplane by stating the tensile strength requirement in the Heat Treat title block of the drawing.

(b) Annealing

(1) The furnace shall be at a temperature of not more than 595°C when parts are inserted.

(2) The temperature of the furnace shall then be gradually raised to 870°C and the parts held at this temperature until they are uniformly heated. The parts shall then be allowed to cool slowly in the furnace to not more than 595°C before being removed.

(c) Normalizing

(1) The furnace shall be at a temperature of not more than 595°C when parts are inserted.

(2) The temperature of the furnace shall then be gradually raised to 870°C and the parts held at this temperature until they are uniformly heated. The parts shall then be withdrawn from the furnace and allowed to cool naturally in still air.

(d) Hardening

(1) The furnace shall be at a temperature of not more than 595°C when parts are inserted.

(2) The temperature of the furnace shall then be gradually raised to from 860°C to 870°C. The temperature and time to be used will depend on the nature of the parts and the thickness of the metal. For thin sections (4.97 mm. or less), the lower temperature shall be used and the heating period shall not be longer than is absolutely necessary.

(3) Hold parts at the quenching temperature (860°C to 870°C) for 15 minutes, or longer if necessary to insure uniform heating of the parts.

(4) Quench in oil, the temperature of which shall be between 10° and 40°C.

(e) Tempering

(1) The furnace shall be at a temperature not above that at which tempering is to be done, or in any case not more than 425°C when the parts are inserted.

(2) Raise the temperature to the desired tempering temperature and hold at this temperature for from 30 minutes to one hour, depending upon the thickness of the metal.

(3) Remove from furnace and allow to cool naturally in still air.

(4) Tables following show temperatures to produce the physical properties indicated:

TEMPERING TEMPERATURE °C	MINIMUM TENSILE STRENGTH KGS PER. CM^2	ROCKWELL HARDNESS RANGE
325°	14,000	C42-C46
410°	12,300	C37-C42
475°	10,500	C32-C37
580°	8,800	C27-C32

MINIMUM PER CENT ELONGATION IN
TWO INCHES

DIAMETER OR THICKNESS (MM.)	MINIMUM TENSILE STRENGTH (KGS.PER CM^2) 8,800	10,500	12,300	14,000
up to .711	2.0	1.2	1.0	1.0
.736 " 1.701	4.0	2.5	1.5	1.0
1.727 " 3.149	6.5	5.0	3.0	2.0
3.175 " 6.451	9.0	7.0	5.0	4.0
over - 6.451	10.5	8.5	5.5	4.5

11. <u>Carbon Steel #1025</u>

Normalizing

(a) The temperature of the furnace should not exceed 595°C when the parts are inserted.

(b) Heat the parts gradually to 890°C. Hold for 20 to 45 minutes, depending on the thickness of the parts.

(c) Remove the parts from the furnace and allow them to cool in still air. Rockwell hardness after normalizing should be B-62 to B-75.

12. <u>Spring Steel #1095</u>

Hardening

(a) Bring furnace up to 540°C maximum.

(b) Insert parts and raise temperature to from 815°C to 845°C during a period of 60 minutes.

(c) Hold at 815° - 845°C for 5 minutes.

(d) Quench in oil until cold.

Annealing and Normalizing

(a) The furnace should not be over 650°C when the parts are inserted. The temperature of the furnace should be gradually raised to 800°C - 835°C and held until the part is uniformly heated.

(b) Quench in still air.

Tempering

(a) Bring the furnace to 345°C - or that temperature which will produce final hardness. Rockwell C44- C50 requires a tempering range of 425°C to 455°C.

(b) Insert parts and hold at 425°C for 30 minutes.

(c) Cool in still air.

13. Strain and Embrittlement Relief

(a) Springs, bearings and similar parts fabricated from steel containing more than 0.6 per cent carbon and with a final diameter and thickness less than 6.35 mm. shall be baked for three hours at 205°C after cadmium plating.

14. SAE 2330 Steel (Normalizing Temp 900°C to 955°C)

Hardening

(a) Insert parts in furnace heated to not more than 650°C.

(b) Raise temperature to 785°C - 815°C during a period of 45 minutes, hold at that temperature for 30 minutes.

(c) Quench in oil.

(d) Re-insert in furnace at draw temperature and hold for a period of time depending on the size and mass of the part.

(e) Cool in still air.

DRAW TEMPERATURE AND PHYSICAL VALUES

TEMPERATURE DEGREES °C	TENSILE KGS. PER CM^2	YIELD KGS. PER CM^2	ELONGATION PER. CENT.	ROCKWELL HARDNESS RANGE
650	7,900	6,970	20-25	C20-C24
595	8,500	7,870	18-22	C22-C26
540	8,800	8,300	15-22	C26-C28
485	9,500	9,000	14-20	C28-C31
425	10,700	10,270	12-16	C30-C33

15. CASTINGS: Do not attempt to repair any casting by welding except castings which were originally welded in place.

B. FIELD REPAIRING

1. Since field repairs might be of such diversified nature, it is obvious, that no exact solution can be given here. The following paragraphs, however, do given general instructions for emergency repairs of various typical parts of the airplane.

2. Materials

(a) The fuselage, center section and wings, tail surfaces, and engine cowling, are almost entirely composed of 24 ST (or 24 SO hardened) Alclad material. This material cannot be satisfactorily welded, hence rivets or bolts must be used in the attachment of one part to another.

(b) In making field repairs, the structural strength should be of primary concern. Generally speaking, any material removed should be replaced by an equal cross sectional area. The new material should lap over the other metal far enough for a good splice in order that the new piece may pick up its share of imposed loads. Rivets should preferably be used to attach a thin gage sheet to another part.

(c) If it is necessary to repair extruded stiffeners, a section could be formed from 24ST material whose cross sectional area is at least equal to the extruded section and whose shape is similar to the replaced part. As in sheet replacements, a new section of stiffener should extend sufficiently far on each side of the cut-out so as to allow proper strength transfer. Again, riveted attachments are preferred, but a splice using all bolts would be permissible.

3. Wings and Tail Surfaces

(a) In case a damaged part in the wing or tail surface is located where there is no access hole nearby to permit work to be done, a hand hole must be cut in the skin. This hole should be kept as small as possible. A hole 9 cm. wide by 12 cm. long should be sufficient for most any type of repair work. Hand holes should be either round or elliptical. Consideration should be given for the location of the hole so that a minimum number of cut-outs be made. Also the hole should be placed in the sheet as far from web flanges and cover stiffeners as is possible. Nearly every web and bulkhead has generous size lightening holes which allow accessibility between compartments. Care should be taken to remove all burrs, minute cracks and cuts from the edges of newly cut holes in order to avoid cracks from developing later. Reinforcing plates should always be put around hand holes. Reference should be made to the hand holes now existing in the manufactured wing between webs #4 and #5 in the lower cover as an example of satisfactory hand hole and reinforcement installations. Refer also to Diagram #4090720 on page IV - 5 which shows typical hand holes and reinforcements for the upper and lower wing cover sheets.

4. <u>Tanks - Fuel and Oil</u>

(a) The fuel and oil tanks are both subject to possible field repair. These tanks are made of 52 S aluminum material. If any replacements are necessary they should, of course, be made with 52 S aluminum. This material may be repaired by gas welding, alone or in addition to riveting. If rivets are used, the head should be welded over in order to make the tank liquid tight. Before starting any welding operations on fuel or oil tanks, follow instructions on page X - 4 regarding welding of tanks.

5. <u>Steel - Repairs by Welding</u>

(a) Steel is used in several assemblies, mostly the engine mount, bomb racks, landing gear and miscellaneous supports for power plant and fuselage furnishing items. In case steel tubes are to be repaired, "fish mouth" splices should be made by welding. A "fish mouth weld" consists of two tapered points, each with an included angle of approximately 60°. These points are diametrically opposite. "Butt Joint" splices are definitely to be avoided in splicing support tubes.

(b) Since the use of heat treatment in field repairs is not probable, the damaged part should be replaced by a member of heavier gage so as to counteract the weakening effect of weld strains.

6. <u>Landing Gear</u>

(a) In the event of damage to the landing gear, which is composed principally of forged and high heat treated parts, very little field repair can be accomplished. Some parts of the shock absorber may be machined from chrome molybdenum steel, but since the proper heat treatment equipment would probably not be available, the temporary part would be much under-strength. If wheels or landing gear fittings are completely damaged, they should be replaced by new spare parts, as duplication of these parts in the field would be, in all probability, impracticable. These parts however, should suffer little damage.

(b) If the adjacent wing structure, or attaching rivets fail, they may easily be replaced with corresponding material. If the rivet holes should be distorted, a larger size rivet or bolt should then be used. Damage sustained by the airplane due to landing with the wheels retracted will probably be confined mainly to the landing flaps, fuel line fairing and propeller.

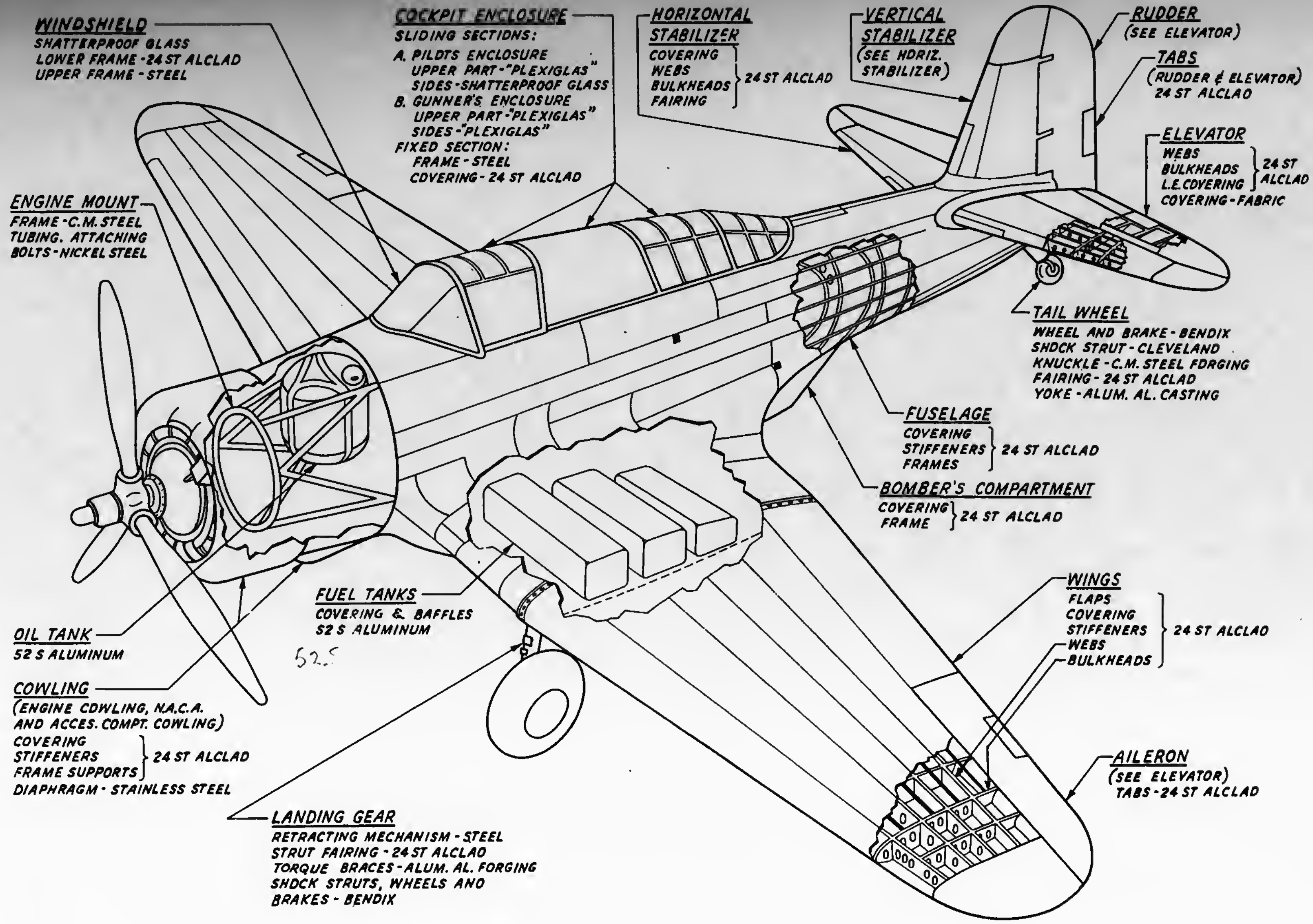
7. Fuel lines and Propeller

(a) If a landing is made with wheels retracted the fuel lines should be thoroughly inspected and replaced if necessary.

(b) The propeller, if damaged, must be replaced, since safe repair of the blades can only be accomplished where the necessary equipment is available.

8. Summary

(a) In any field repairs, where the available equipment may not be the best, it is necessary that the workmanship be of the highest quality, that equivalent materials should be used where replacements are necessary. Particular attention should be given to the strength phase by allowing generous overlaps in splices and by replacing material with at least equal cross sectional area.



MATERIAL CHART

SECTION XXV

FINISHES

A. GENERAL

1. This section covers the methods and materials to be used in the preparation for, and application of, protective coatings for aircraft parts and surfaces such as fuselage, wings, cowling, etc. Protective coatings defined herein are not to be construed as applying to equipment and accessories unless referred to specifically.

2. Unless otherwise specified, no additional protective treatment should be given to Government furnished equipment to which a protective coating has been originally applied.

3. The operations listed under "Requirements" have been adhered to by the El Segundo Division in the general finishing of the airplane and should be referred to whenever refinishing is necessary.

B. REQUIREMENTS

The following requirements are arranged alphabetically for quick reference:

1. Acid Proof Paint

(a) Acid proof paints should be applied to the surface of the following:

(1) The battery container and supports.

(2) The area within a radius of 30 cms. of the battery container and all brackets, fixtures and other materials that may be affected by battery acid.

(b) Acid proof paint may be applied directly onto the metal although the presence of zinc chromate primer is not objectionable.

2. Aluminum Pigmented Compound

(a) Aluminum pigmented compounds should be mixed for immediate use only, in order to obtain proper leafing of the aluminum powder or paste.

(b) Where aluminized material is specified it shall be mixed in proportions as shown in paragraph 31.

3. <u>Aluminum - Welded</u> (cleaning of)

(a) Welded aluminum parts should be thoroughly cleaned in a 10 per cent sulphuric acid solution as soon as practicable after welding to insure complete removal of welding flux. After cleaning, parts should be thoroughly washed in running water and carefully dried.

4. <u>Anodic Treatment</u>

(a) All aluminum alloys including materials listed in (c), should be given the anodic treatment, with the exception of materials listed in (d).

(b) In order to obtain maximum protection from the anodic coating, as much forming, drilling and cutting should be performed on the parts prior to treatment, as is practicable. With the exception of parts assembled by welding and parts which are not under stress, all parts should be treated in detail before assembly.

(c) Materials included in aluminum alloys to be given the anodic treatment:

(1) All fuel and oil tanks and lines except those fabricated from 17S or 24S aluminum alloy.

(2) Aluminum alloy castings with male tapered threads.

(3) Aluminum alloy forgings with male tapered threads.

(4) All rivets of heat treatable alloys such as 17S and A17S should be given either the chromic acid or sulphuric acid anodic treatment.

(d) The exceptions to the anodic treatment are as follows:

(1) Aluminum alloy castings with or without female threads.

(2) Aluminum alloy forgings with or without female threads having a diameter or wall thickness greater than 3 m. m.

(3) Aluminum or aluminum alloy parts in the electrical system.

(4) All instrument panels.

(5) All aluminum products of the following designation: 2S, 3S, 51S, 52S and 53S.

(6) Non-structural aluminum alloy parts (not Alclad coated) in spot welded assemblies.

(e) The initial coat of primer should be applied as soon as possible after anodic treatment.

5. Anti-glare Coatings

(a) All exterior surfaces that require an anti-glare coating should be given an initial coating of zinc chromate primer followed by two coats of flat bronze green lacquer.

6. Anodizing and Painting - Assemblies

(a) The following parts should be anodized, if required, and given one coat of primer before assembly.

(1) Individual parts of stressed assemblies, fuselage, and empennage parts.

(b) Where size permits, the following parts may be assembled, anodized, if required, and given the specified protective coating after assembly, provided the assembly is made only of aluminum and aluminum alloy parts:

(1) Non-stressed assemblies, such as map cases, flight report holders, ammunition racks, cowl parts, seats, floors, etc.

7. Bonding

(a) When anodized rivets are used, bonding to .001 ohm resistance should be accomplished by use of one 3.1 mm diameter un-anodized aluminum rivet, with special marked head. One such rivet is to be used on all non-structural parts attached with less than 20 rivets.

(b) When parts are attached by bolts, the finish coats on the contacting surfaces of the parts should be removed (through anodic) at one bolt point on each part.

8. Brass, Bronze and Copper Parts

(a) Brass, bronze and copper parts in contact with other metals, or with wood, should be cadmium plated.

(b) Brass, bronze and copper parts, except as mentioned in (a) above and (c) below, should be finished the same as other metal parts. See paragraph 32.

(c) Copper tubing should be cleaned and given one coat of clear lacquer on the outside only.

(d) End fittings on copper tubing annealed after assembly should not be cadmium plated.

9. Cables and Wires

(a) Control cables should not be painted, but should receive a thorough coating of rust-preventive compound. Corrosion-resistant steel cables may be given a light coat of oil or grease.

10. Cadmium Plating - See Paragraphs 30 and 31.

11. Chromate Treatment

(a) All magnesium and magnesium-base alloy parts and surfaces should receive a chromate treatment.

12. Cleaning (General)

(a) All surfaces should be thoroughly cleaned and dry at the time of application of any protective coating. Once a surface has been cleaned it should not be touched with dirty or greasy hands or objects. Surfaces shall be given the initial specified finish coat as soon as practicable after cleaning.

(b) Any cleaning compound which has a deteriorating effect on the material to be cleaned should not be used. Parts which have been cleaned should be thoroughly washed in running water to insure removal of the cleaning compound.

13. Cleaning - Unplated Parts

(a) The loose scale on all unplated steel parts should be removed by wire brushing, pickling or sandblasting and thoroughly cleaned with diluent or thinner before the finish is applied.

14. Corrosive Materials

(a) Rawhide, untreated fabrics, or composition materials containing chlorides, should never be used in contact with aluminum or aluminum alloys.

(b) Whenever it is necessary to lace together parallel tubes, whether of steel, copper, aluminum or aluminum alloy, lacquered oil tanned russet leather lacing, shall be used.

15. Cowling

(a) The interior surface of aluminum cowling need not be painted.

16. Dissimilar Metals

(a) Dissimilar metal contacts, especially those between aluminum alloys and the alloys of copper or nickel, should be avoided whenever practicable. Copper alloys and steel parts in contact with aluminum alloys should be cadmium plated and then insulated in accordance with the requirements of paragraph 28.

17. Doping

(a) Fabric covered surfaces should be finished as follows:

(1) Three hand brush coats of yellow semi-pigmented nitrate dope. For brushing, the material shall be used as received by the manufacturer.

(2) Ailerons and elevators, (in addition to the hand brush coats specified in (1) above) should be given three spray coats of aluminized nitrate dope, thinned to the viscosity required for the spraying equipment. The last coat shall be thinned sufficiently to flow out the under coats.

(3) In addition to the hand brush coats specified in (1) above, the rudder shall be finished with three spray coats of insignia color nitrate dope. Such dope must be applied to produce a dope film weighing not less than .07 kgs. per meter^2.

18. Dope Proofing

(a) All metal parts which come in contact with doped fabric should be given one or more coats of zinc chromate primer as a dope proof finish.

19. Electrical System

(a) Flexible conduit, rigid aluminum conduit, conduit fittings and clamps used to install conduit and instrument panel when it forms one side of metal shielding box, should be assembled without protective coating. The conduit boxes should have one coat of zinc chromate primer on external surface.

(b) Parts exposed to view during use of the equipment should be finished on the exterior surface to harmonize with the adjacent surfaces.

(c) Micarta parts used as terminal blocks for wires carrying high frequency current should be given one coat of bakelite varnish on surfaces which have been cut after molding.

20. Exterior (Exposed) Surfaces

(a) Exterior surfaces of non-alclad aluminum alloy should be given one coat of zinc chromate and one coat of aluminized lacquer to match the surrounding areas.

(b) Exterior surfaces of aluminum coated aluminum alloy should have no finish coating except insignia and markings Exterior surfaces of closing section channels of tail surfaces and stabilizers, also wing attaching angles, shall receive one coat of aluminized lacquer.

21. Fabric Surfaces - see Paragraph 17.

22. Firewall

(a) No paint coating (except insulation between dissimilar metals) should be applied to the forward side of the firewall. The aft side of the firewall should have two coats of primer and one coat of yellow green finish.

23. Fluid Pipe Lines (Marking of)

(a) At the factory all pipe lines have encircling bands painted near each end and at such intermediate points as may be necessary to follow through the system. Bands shall be 1.25 c.m. wide and approximately 2.5 c.m. from ends or fittings unless otherwise noted. Where more than one band is required additional bands of the same width shall be added approximately 3 m.m. apart.

(b) The following colors will be used to identify the contents of piping:

SYSTEM	FIRST BAND	SECOND BAND	THIRD BAND
Fuel..........................	Yellow		
Oil (Lubricating).............	Brown		
Air Speed (Pitot Pres.).......	Black		
Air Speed (Static Pres.)......	Black	Light Green	
Fire Extinguisher	Red		
Oxygen	Light Green		

SYSTEM	FIRST BAND	SECOND BAND	THIRD BAND
Manifold Pressure	White	Light Blue	
Vacuum	White	Light Green	
Hydraulic	Light Blue	Yellow	Light Blue
Air Pres. (Compressed)	Light Blue	Light Green	
Aero Mix. Indicator	Light Blue	Brown	
Vent (Closed Compartments)	Red	Black	

24. Fuel and Oil Tanks and Lines (Finish of)

(a) Aluminum fuel and oil tanks should be cleaned as specified in paragraph 3, to be followed by flushing the interior with light oil and then drained.

(b) The exterior surfaces of fuel tanks only should be coated with one coat of zinc chromate primer after receiving anodic treatment.

(c) The oil tank should have no finish applied.

(d) Fuel and oil line of aluminum should have no finish applied.

(e) Supports for oil tank consist of metal straps, bolted to engine mount and cushioned by molded neoprene. As an alternative for the neoprene cushion, felt impregnated with varnish, spar or seam compound or other water resistant material, encased in a fabric covering water-proofed, as above, should be used.

(f) Burlap tank straps should be treated with water resistant material.

25. Greasing

(a) Threads on adjustable parts which are disconnected or disassembled should be greased before assembly.

26. Gunner's Seat Assembly

(a) The gunner's seat ring and the gun ring are buffed and anodized and need no further treatment. The metal rollers are also anodized and need no finish.

(b) The gunner's seat, cross tube under seat and assembly castings should be finished with a coat of yellow green primer.

27. Interior Parts and Surfaces, Finish For

(a) Interior metal surfaces should be given two coats of primer except aluminum and aluminum coated alloy surfaces which should be given one coat of primer.

(b) Ailerons, elevators and rudder should be given two coats of zinc chromate primer.

(c) The interior of the fuselage and gun compartments in the wing and parts per (d) below, should have an additional coat of yellow green finish.

(d) Parts on the inside of the engine section (front mounting ring to firewall) should be left without finish except unplated steel parts, such as engine mount, and those parts as may be specifically requested finished.

(e) The interior surfaces of the center section flap area and the interior surfaces of the wing flap area should receive as a final finish, one coat of aluminized lacquer.

(f) The interior side of wing, gun doors and wing fairing should receive no finish coating. The interior of fairing at stabilizer should receive one coat of zinc chromate primer and one coat of aluminized lacquer.

28. Joints and Seams

(a) All external overlapping portions (surfaces in contact) should be assembled in the most convenient manner, wet or dry, each surface having had two coats of primer applied to it before joining, except for the following:

(1) All parts joined by welding, brazing or soldering.

(2) Aluminum and aluminum alloy parts which are anodized after assembly.

(3) Steel and brass parts which are cadmium plated after assembly.

(4) Contact parts of attachment fittings which act as connections between the various units of the airplane, such as attachment of wings to the fuselage engine control brackets and other accessories.

(5) Terminals for electrical, radio or bonding connections.

29. Marking and Labeling

(a) Markings have been made in accordance with Detail

Specifications for this airplane.

(b) Fluid line identification markings will be found in paragraph 23.

30. Materials

(a) Aluminum Paint Coatings - The following table gives the recommended quantities of aluminum paste to be used where aluminum pigmented paint coatings are specified. The quantities are based on one 3.7 liter package material before reduction.

Paste - Type B

Spar Varnish	6.8 kgs.
Clear Nitrate Dope	.45 kgs.
Clear Lacquer	.45 kgs.

Aluminum pigmented compounds should be mixed for immediate use only, so as to obtain proper leafing of the aluminum paste.

(b) Application of Primer (shop coating) - All metal parts should be given one coat of plain zinc chromate primer immediately after cleaning, plating or anodic treatment to prevent scratching of sheets during fabrication.

(c) Application of Paint Coatings - The initial paint coating should be applied as soon as possible after cleaning, plating or chemical treatment. The top or final coating should be applied after assembly is complete, whenever possible. Both primer and finish coatings should be applied by spraying or dipping, except that touch up spots may be applied by brush.

(d) Shop Coating (Primer for Alclad Sheets) - The shop coating referred to consists of zinc chromate primer. This coating should be applied to all Alclad sheets in the ST temper immediately after receipt from the mills. On assembly the interior finish for such surfaces should be completed by applying one coat of finishing material in accordance with the color scheme specified.

(e) Yellow Green Finish - Preparation should be accomplished by use of the following table:

Zinc Chromate Primer	3.7 liters
Enamel, Black	0.3 liters
Aluminum Powder	0.11 kgs.
Toluene	3.7 liters

(f) Thinners: - Thinners used for the reduction of dopes and/or lacquers should conform to specifications recommended by the manufacturer for the particular lacquer and/or dope.

(g) Other Materials: -

Dope

Nitrate (clear)
Red, for insignias
White, for insignias
Blue, for insignias

Chromate Treatment

All magnesium and magnesium alloy parts and surfaces should be treated in accordance with Douglas Process Bulletin #225.

Cleaning

Naphtha, Toluol, Carbon Tetrachloride.

Cadmium

Cadmium Metallic
Cadmium Bright Dip

Lacquer

Clear Lacquer
White, for insignias
Blue, for insignias
Red, for insignias

Primer (Metal)

Zinc Chromate

Paint (Acid Resistant)

Black

31. Metal Parts (Cadmium Plating)

(a) All steel, brass of copper parts, in contact with other metals, should be cadmium plated with the exception of structural tubing and the following:

(1) Parts manufactured from corrosion resistant or stainless steel.

(2) Welded structures that are too large for plating equipment available.

(3) Parts welded to unplated structures, such as cowling supports, steps, etc.

(4) Cables and parts fabricated from tinned wire; such as control cables and springs, and tie rods unless the finish is specifically called for on drawings.

(5) Members or portion of members that act as bearings or journals.

(6) Cowl formers and supports fabricated from steel tubing. If any such members are closed, they should be oiled in accordance with paragraph 44.

(7) Pilot's enclosure framework.

(8) All non-structural parts which contain closed sections from which the plating solution cannot be removed by the customary rinse. These parts are to be finished in accordance with paragraph 44.

(9) Engine mounts, copper tubing, and the interior of all hydraulic fittings.

(10) Springs and parts which are entirely immersed in hydraulic fluid or oil. (After cadmium plate, springs should be treated for embrittlement relief as specified on page XXIV - 8).

(b) Steel surfaces should be cleaned before plating by immersion in a hot plater's cleaner.

(c) Steel surfaces which act as a movable bearing should not be plated but should be given a coat of grease.

(d) Cadmium plated parts which are to be painted should be immersed 1 to 2 minutes in a 3 to 5 per cent solution of chromic acid, and then rinsed thoroughly in clear water. This procedure improves the adhesion of paint to cadmium plating.

(e) A plating of tin may be used in lieu of cadmium on parts which are subsequently soldered.

32. <u>Metals - Dissimilar</u> - see paragraph 16.

33. <u>Paint (Application of)</u> - See paragraph 30, (c).

34. Paint (Omission of)

(a) No paint should be applied to wearing surfaces, screw threads or oil holes. Rubber should not be painted, greased or oiled. Paint should not be applied to fittings in such a way as to cause the bearings to seize.

(b) Brass, corrosion-resistant steel and cadmium plated steel parts in engine compartment need not be painted unless specifically required.

(c) No paint coating should be applied to the forward side of the firewall. Parts on inside of engine section (from mounting ring to firewall) should be left without finish, except unplated steel parts such as engine mount and parts specifically requested finished.

(d) The interior side of wing, wing fairing, and gun doors should receive no finish coating.

(e) The oil tank and those fuel line of aluminum should have no finish coating.

(f) Interior surface of aluminum cowling need not be painted.

35. Parts (Standard)

(a) Bolts, pins, rivets, etc.

(1) After driving, rivet heads and points should be inspected and touched up with the specified initial finish.

(2) All purchased cadmium parts should be dipped in a 5 per cent chromic acid solution prior to the first coat of primer.

36. Parts (Threaded)

(a) Threads on adjustable parts such as tie-rods, turnbuckles, etc., should be greased before assembly; threads on parts that are not adjustable or that are not to be removed when the airplane is dismantled for crating or packing, need not be greased but should be coated after assembly with primer and touched up to match the adjacent surface.

37. Rubber

(a) Paint, grease or oil should not be applied to rubber or synthetic products such as neoprene, unless specified.

38. Springs

(a) Bronze and cadmium plated steel springs should not be painted unless they form part of an assembly requiring a final finish at which time the cadmium plated spring may be painted simultaneously.

39. Steps and Walkways

(a) See page IV - 3 for finishing of walkways.

(b) Steps should not be painted.

40. Straps - Tank (Protection of)

(a) Straps for tanks should be finished as specified in paragraph 30, (a).

(b) For oil tank straps see paragraph 24, (e)

(c) Felt pads for fuel tanks should be attached to the tanks with plasticon or equivalent. After attachment, free surfaces should be coated with paraffin.

(d) Burlap pull straps for fuel tanks should be treated with water resisting material.

41. Thinners

(a) See paragraph 30, (f).

42. Tube - Aluminum Alloy Closed (Interior Finish)

(a) The interior surfaces of closed aluminum alloy tubes should be given one coat of zinc chromate primer and allowed to dry before closing the ends.

43. Tubes - Aluminum Alloy Open (Interior Finish)

(a) The interior surface of all open ended aluminum alloy and steel tubular parts shall be given one coat of zinc chromate primer either by dipping or filling, and allowed to drain.

44. Tubes - Steel, Closed

(a) After welding or brazing operations have been completed, the interior of closed steel tubular members should be protected by a coat of hot raw linseed oil. The linseed oil should be applied by forcing it under pressure or by immersing the part in a bath of linseed oil at a temperature of not less than 70°C and allowing it to remain for not less than two minutes. The liquid may be forced into each individual tube by drilling small holes close to the end of the members, or may be forced through the complete assembly by drilling interconnecting holes in the strut joints. If immersed, the parts should be manipulated to insure the absence of air pockets and should remain in the bath until all bubbling has ceased. The presence of liquid in the tubes may be checked by noting the increase in temperature. The members should be drained and wiped free from oil on exterior surfaces. All holes drilled in the members which are open to the outside should be sealed with cadmium plated drive screws. Solder should not be used to close these holes.

45. Tubes - Open

(a) The interior surface of all open ended aluminum alloy and steel tubular parts shall be given one coat of zinc chromate primer either by dipping or filling, and allowed to drain.

46. Watertighting of Wings

(a) The assembly of the watertight portion of the wings should be as follows:

(1) Internal faying surfaces should be assembled with Herringbone Tape impregnated with Dolfinite.

(2) The internal portion of the stiffeners should be plugged with cork dipped in Dolfinite.

(3) The joint around the stiffeners should be fitted with canton flannel patch sealed with Dolfinite.

(4) The faying surfaces of external joints should be assembled with Dolfinite impregnated tape between laps.

(5) On all seams and patches apply a heavy coat of Bakelite varnish after the primer or lacquer touch up has been completed, over the completed joint. The excess Dolfinite material should be removed by scraping, etc., before the application of the varnish.

47. Wearing Surfaces and Oil Holes

(a) Care should be used to prevent the application of paint materials to wearing surfaces, threads and oil holes.

48. Wrapping and Supports

(a) Where a felt pad is necessary, a fabric jacket should be sewn around the pad and the assembly given one dip coat of Lionoil and allowed to dry before assembly into the airplane.

(b) Whenever it is necessary to lace together parallel lines, whether of steel, copper, aluminum or aluminum alloy, oil tanned russet leather lacing should be used for this purpose.

(c) Rawhide or untreated fabric should not be used as a wrapping material.

(d) The wrapping of structural members to facilitate fastening of fabric coverings tends to promote corrosion and should be eliminated whenever practicable. Lower longerons and lower cross-member should not be wrapped.

SECTION XXVI

CRATING FOR SHIPMENT

A. GENERAL

1. When crating and shipment of this airplane was accomplished, it was carefully disassembled and prepared for transportation in the manner described in this section and should be received in perfect condition

2. Before crating all external exposed metal surfaces were covered with a protective coating (#7 Rust-Veto). When airplane is assembled this protective coating should be removed. An efficient solvent for removing the protective coating is naptha (the petroleum derivative).

3. Crate #1, the designation for that crate which contains the fuselage with all its appurtenances, including engine (when installed) and accessories, landing gear, cockpits and enclosures, bombers compartment, instruments, controls, vertical and horizontal stabilizers, rudder, elevators, tail wheel assembly and their parts for assembly, are carefully crated. The propeller is within a crate built especially for it and is part of the contents of crate #1.

4. Crate #2, is the designation for that crate which contains the left and right wings, complete with ailerons, flaps and tips and their attaching parts.

B. UNCRATING

1. Crate #1 is built in panels and should be disassembled one panel at a time. The top is in one panel. Each end is a complete panel and an entrance door has been built for access at the aft end. Each side or wall is a complete panel. All panels are fastened together with bolts and lag screws and mounted on a substantial floor section. Before uncrating, enter the door in the end and note the construction and the use of bolts and lag screws, then follow in sequence the instructions listed below:

   (a) Remove the roofing material from top and the 1 in. x 4 in. (2.5 cm. x 10 cm.) cleats from around top edge.

   (b) Remove lag screws or bolts for the top sections and remove.

   (c) Remove lag screws for rear end and remove rear end.

(d) Remove all equipment attached to walls and forward end.

(e) Remove left wall by unbolting.

(f) Brace right wall from falling inward.

(g) Remove forward end by unbolting.

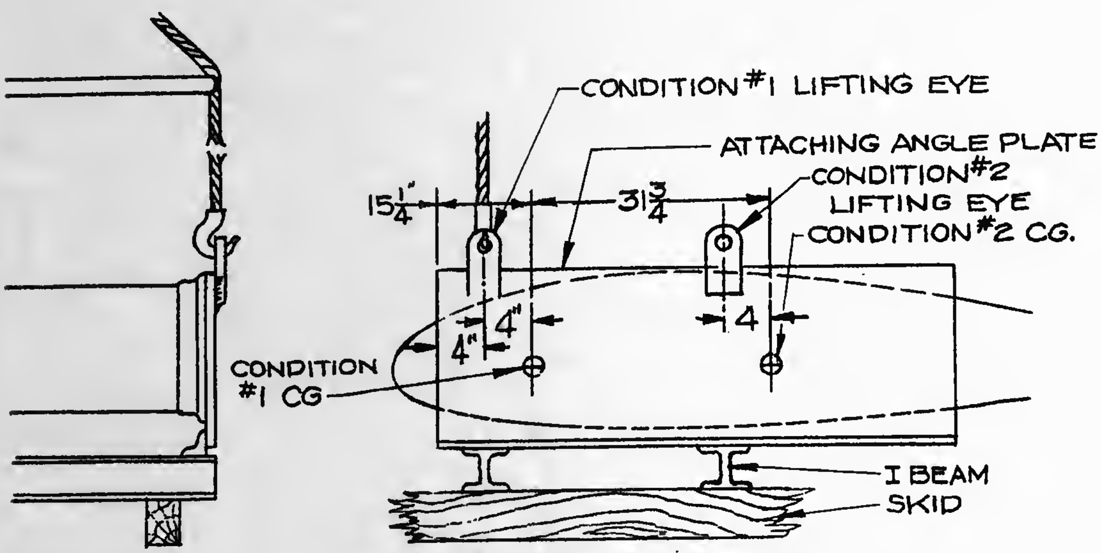
(h) Remove right wall.

(i) Remove crates and other materials bolted to the floor.

(j) The fuselage now remains anchored to the eye beam bolted to the floor. Steel plates bolted to the eye beam and center section attaching angles, together with anchor post under tail jack pad, support the airplane in the crate.

(k) The propeller in a crate bolted to floor can be removed now or later.

(l) Attach hoisting tackle to the proper locations on the attaching angle steel plate as shown in sketch below. Use of spreader bar is recommended in all hoisting operations to prevent possible damage to wing. Draw up on tackle to take the load. Station sufficient men at tail to balance the airplane during hoisting operations. Unbolt the steel plates from the eye beam, remove supporting rod from tail and lift airplane to a clear space and place in a level position.



CONDITION #1 WITH ENGINE
CONDITION #2 - WITHOUT ENGINE

(m) Extend landing gear and lower onto a support. Use tail wheel stand until tail wheel is installed (see pages III - 1 and III - 2).

2. Crate #2, remove the roofing material from top and the 1 in. x 4 in. (2.5 cm x 10 cm) cleats from around top edge and through center.

(a) Remove lag screws and bolts from the top - remove top.

(b) Remove one end and one side wall.

(c) Brace remaining end from falling inward and remove remaining wall.

(d) Remove remaining end.

(e) Unbolt wings from metal plates secured to floor, cut burlap straps and lift out wings.

C. ASSEMBLY

1. The parts should be installed in the following order:

(a) Horizontal and vertical stabilizers. See Section V.

(b) Tail wheel assembly. See Section VII.

(c) Elevators and rudder. See Section V.

(d) Wings. See Section IV.

(e) Propeller. See "Installation and Maintenance Instructions", Curtiss Electric Propeller.

(f) For electrical installation, see Section XXI.

(g) For adjustment of flight (surface) controls, see Section XX.

(h) For connecting and adjusting flight instruments, see Section XXII and in particular - instructions regarding the Aero Mixture Indicator.

(i) For instructions consult the section on subject in question by referring to the Index of Sections at beginning of this manual.

(j) See XXVI - 4 and XXVI - 5 for photographs of crating.